NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION

STS-54

PRESS KIT

JANUARY 1993

TRACKING AND DATA RELAY SATELLITE

DIFFUSE X-RAY SPECTROMETER

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MEDIA SERVICES INFORMATION

NASA Select Television Transmission

NASA Select television is available on Satcom F-2R, Transponder 13, located at 72 degrees west longitude, frequency 3960.0 MHz, audio 6.8 MHz.

The schedule for television transmissions from the orbiter and mission briefings will be available during the mission at Kennedy Space Center, Fla; Marshall Space Flight Center, Huntsville, Ala.; Ames-Dryden Flight Research Facility, Edwards, Calif.; Johnson Space Center, Houston, and NASA Headquarters, Washington, D.C. The television schedule will be updated to reflect changes dictated by mission operations.

Television schedules also may be obtained by calling COMSTOR 713/483-5817. COMSTOR is a computer data-base service requiring the use of a telephone modem. A voice update of the television schedule is updated daily at noon Eastern time.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA newscenter.

Briefings

A mission press briefing schedule will be issued prior to launch. During the mission, status briefings by a flight director or mission operations representative and when appropriate, the science team will occur at least once per day. The updated NASA Select television schedule will indicate when mission briefings are planned.

STS-54 QUICK LOOK

Launch Date/Site:	Jan. 13, 1993/Kennedy Space Center, Fla. -- Pad 39B
Launch Time:	8:52 a.m. EST
Orbiter:	Endeavour (OV-105) - 3rd Flight
Orbit/Inclination:	160 nm/28.45 degrees
Mission Duration:	5 days, 0 hours, 23 minutes, 32 seconds
Landing Time/Date:	8:34 a.m. EST, Jan. 19, 1993
Primary Landing Site:	Kennedy Space Center, Fla.
Abort Landing Sites	Return To Launch Site Abort: KSC, Fla TransAtlantic Abort Landing: Banjul, The Gambia Ben Guerir, Morroco Moron, Spain Abort-Once-Around: Edwards AFB, Calif. KSC/White Sands
Crew:	John Casper - Commander Don McMonagle - Pilot Mario Runco, Jr. - MS1 (EV2) Greg Harbaugh - MS2 (EV1) Susan Helms - MS3
Cargo Bay Payloads:	Tracking and Data Relay Satellite-F Diffuse X-ray Spectrometer
Middeck Payloads:	Commercial Generic Bioprocessing Apparatus Chromosome and Plant Cell Division in Space Experiment Physiological and Anatomical Rodent Experiment Space Acceleration Measurement System Solid Surface Combustion Experiment

STS-54 SUMMARY TIMELINE

Flight Day One

Launch/post insertion
TDRS-F deploy (nominal deploy is 6 hours, 13 minutes MET)
Separation burn (178 n.m. x 162 n.m. orbit)
DXS activation

Flight Day Two

DXS operations
Circularization burn (162 n.m. x 162 n.m. orbit)
CGBA operations
Medical DSOs

Flight Day Three

DXS operations
CGBA operations
SSCE operations
CHROMEX/PARE operations

Flight Day Four

DXS operations
CGBA operations
Medical DSOs
CHROMEX/PARE operations

Flight Day Five

DXS operations
EVA

Flight Day Six

Flight Control Systems checkout
Cabin stow

Flight Day Seven

Deorbit Preparation
Deorbit Burn
Entry
Landing

STS-54 VEHICLE AND PAYLOAD WEIGHTS

Vehicle/Payload	Pounds
Orbiter (Endeavour) Empty and three SSMEs	173,174
Tracking and Data Relay Satellite-F (TDRS-F)	5,586
Two-Stage Inertial Upper Stage (IUS)	32,670
Diffuse X-ray Spectrometer (DXS)	2,625
Medical Detailed Supplementary Objectives (DSOs)	34
Total Vehicle at Solid Rocket Booster Ignition	4,525,222
Orbiter Landing Weight	205,000

STS-54 ORBITAL EVENTS SUMMARY

Event	**Elapsed time**	**Velocity change**	**Orbit (nm)**
Launch	0:00:00:00	N/A	N/A
OMS-2	0:00:42:00	221 fps	163x160
TDRS deploy	0:06:13:00	N/A	163 x 160
Sep 1	0:06:14:00	2.2 fps	162 x 160
OMS-3	0:06:28:00	31 fps	178 x 162
OMS-4	1:02:09:00	28 fps	162 x 161
Deorbit	5:22:32:00	306 fps	N/A
Landing	5:23:32:00	N/A	N/A

SPACE SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward a safe and intact recovery of the flight crew, orbiter and its payload. Abort modes include:

* Abort-To-Orbit (ATO) -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical mile orbit with orbital maneuvering system engines.

* Abort-Once-Around (AOA) -- Earlier main engine shutdown with the capability to allow one orbit around before landing at either Edwards Air Force Base, Calif., White Sands Space Harbor, N.M., or the Shuttle Landing Facility (SLF) at the Kennedy Space Center, Fla.

* Trans-Atlantic Abort Landing (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at either Banjul, The Gambia; Ben Guerir, Morocco; or Moron, Spain.

* Return-To-Launch-Site (RTLS) -- Early shutdown of one or more engines, without enough energy to reach Banjul, would result in a pitch around and thrust back toward KSC until within gliding distance of the Shuttle Landing Facility.

STS-54 contingency landing sites are Edwards Air Force Base, the Kennedy Space Center, White Sands Space Harbor, Banjul, Ben Guerir and Moron.

STS-54 PRELAUNCH PROCESSING

Processing of Endeavour began with its landing at KSC after the STS-47 mission. It was deserviced from its previous flight and prepared for the upcoming STS-54 mission. Endeavour spent a total of 64 calendar days in the Orbiter Processing Facility.

The Space Shuttle Endeavour was rolled out of the Vehicle Assembly Building for Pad 39-B on Dec. 3. The TDRS-F/IUS-13 was installed into the orbiter's payload bay the following day.

A standard 43-hour launch countdown is scheduled to begin 3 days prior to launch. During the countdown, the orbiter's fuel cell storage tanks and all orbiter systems will be prepared for flight.

About 9 hours before launch, the external tank will be filled with its flight load of a half million gallons of liquid oxygen and liquid hydrogen propellants. About 2 and one-half hours before liftoff, the flight crew will begin taking their assigned seats in the crew cabin.

Endeavour's end-of-mission landing is planned at Kennedy Space Center's Shuttle Landing Facility. Endeavour's next flight, STS-57, targeted for May 1993, is a planned 7-day mission which will involve the SPACEHAB-1 payload and the retrieval of the EURECA satellite.

TRACKING DATA RELAY SATELLITE-F (TDRS-F)

History

The Tracking and Data Relay Satellite System (TDRSS) is a space-based network that provides communications, tracking, telemetry, data acquisition and command services essential to the Space Shuttle and low-Earth orbital spacecraft missions. All Shuttle missions and nearly all NASA spacecraft in Earth orbit require TDRSS's support capabilities for mission success.

The TDRSS was initiated following studies in the early 1970s which showed that a system of telecommunications satellites, operated from a single ground station, could better meet the requirements of NASA missions. In addition, the system was seen as a means of halting the spiralling costs of upgrading and operating a network of tracking and communications ground stations located around the world.

The TDRSS has enabled NASA to cut telecommunications costs by as much as 60 percent while increased data acquisition and communications with Earth-orbital spacecraft from 15 to 85 percent -- and in some cases to 100 percent -- depending on a spacecraft's orbital position.

In addition to the Shuttle, TDRSS customers include the Compton Gamma Ray Observatory, Upper Atmosphere Research Satellite, Hubble Space Telescope, Cosmic Background Explorer, Extreme Utraviolet Explorer, TOPEX-Poseidon, both Landsat spacecrafts and other non-NASA missions. Among future TDRSS-dependent missions are Space Station Freedom (SSF) and the Earth Observation System (EOS). It is estimated that over $70 billion in space missions through the end of this decade are TDRSS-dependent.

The TDRSS consists of two major elements: A constellation of three geosynchronous satellites -- two operational and one in ready reserve -- and a ground terminal located at White Sands, N.M. A second TDRSS ground terminal is under development to eliminate a critical single point of failure.

To meet the growing demand for communications capabilities for future missions, such as SSF and the EOS, increased TDRSS capacity will be required to meet these additional mission requirements.

Current Status

The Tracking and Data Relay Satellite (TDRS-6) is the sixth in a series of communications spacecraft planned for the TDRSS.

TDRS-1, has exceeded its design life of 7 years and is continuing to provide limited services. TDRS-2 was lost in the Challenger accident. TDRSs 3-5 are operating, but only two are fully functional. In the event of a malfunction of one of these fully operational TDRS, the absence of a third fully operational satellite in ready reserve would severely impact orbiting

customers for nearly a year before an emergency replenishment launch could be conducted.

The successful launch and checkout of TDRS-6 will give NASA the essential requirement of having two fully operational satellites and a fully operational ready reserve capability. This will assure that NASA communications, telemetry and data acquisition capabilities required by space missions will not be jeopardized.

Following the successful launch and checkout of TDRS-6, the TDRSS constellation will be reconfigured. Because of the flexible capability of the TDRSS, one TDRS spacecraft will provide service to the Compton Gamma Ray Observatory (GRO), including realtime transmission of scientific data. This is required because of a problem with the GRO's tape recorders. To accommodate this activity, NASA will operate TDRS-1 thru an existing station at Tidbinbilla, Australia, moving TDRS-1 from 171 degrees west longitude to 85 degrees east longitude (over the Indian Ocean south of Ceylon).

Data from GRO will be relayed to the ground terminal at White Sands, via an Intelsat satellite. From White Sands, the data will be sent to the Goddard Space Flight Center, Greenbelt, Md. Control of the TDRS spacecraft will remain at White Sands.

TDRS SPACECRAFT LAUNCH AND OPERATIONAL STATUS

Spacecraft	**Mission**	**Status**
TDRS-1	STS-6 April 5, 1983	Partially functional
TDRS-2	STS-51L January 1986	
TDRS-3	STS-26 Sept. 29, 1988	Partially functional
TDRS-4	STS-29 March 13, 1989	Fully functional
TDRS-5	STS-43 August 2, 1991	Fully functional

TDRS SPACECRAFT CURRENT AND RECONFIGURED POSITION

Current Position

TDRS-1 171 degrees west (East of Gilbert Islands and South of Hawaii).

TDRS-3 62 degrees west

TDRS-4 41 degrees west (over the Atlantic Ocean off Brazil)

TDRS-5 174 degrees west (East of Gilbert Islands and South of Hawaii).

Reconfigured Position after TDRS-F (6 on orbit)

TDRS-1 85 degrees east

TDRS-3 171 degrees west

TDRS-4 41 degrees west

TDRS-5 174 degrees west

TDRS-6 62 degrees west

Deployment Sequence

TDRS-6 will be deployed from Endeavour cargo bay approximately 6 hours after launch on orbit 5 over the Pacific Ocean north of Hawaii. Injection burn to geostationary orbit will be initiated at 77 degrees east longitude (Indian Ocean, south of India), placing the satellite in orbit at 178 degrees west longitude (over the Pacific near the Gilbert Islands).

The STS-54 crew elevates the Inertial Upper Stage/TDRS (IUS/TDRS) to 29 degrees in the payload bay for preliminary tests and then raises it to 58 degrees for deployment. A spring-loaded ejection system is used for deploying the IUS/TDRS.

The first burn of the IUS booster will take place 1 hour after deployment or about 7 hours after STS-54 launch. The IUS second and final burn, to circularize the orbit, will take place 5.5 hours after the first burn, approximately 12.5 hours into the mission. Separation of the booster and satellite will occur at 13 hours after launch.

Upon reaching geostationary orbit, the deployment of TDRS appendages and antennas is started. The total time required for the deployment sequence is 8-9 hours:

1 - Deploy solar arrays.
2 - Deploy space-ground link boom.
3 - Deploy C-band boom.
4 - Separation of IUS and TDRS.
5 - Release single access booms.
6 - Position single access antennas.
7 - Open single access antennas.

During steps 5, 6 and 7, Earth acquisition is taking place concurrently.

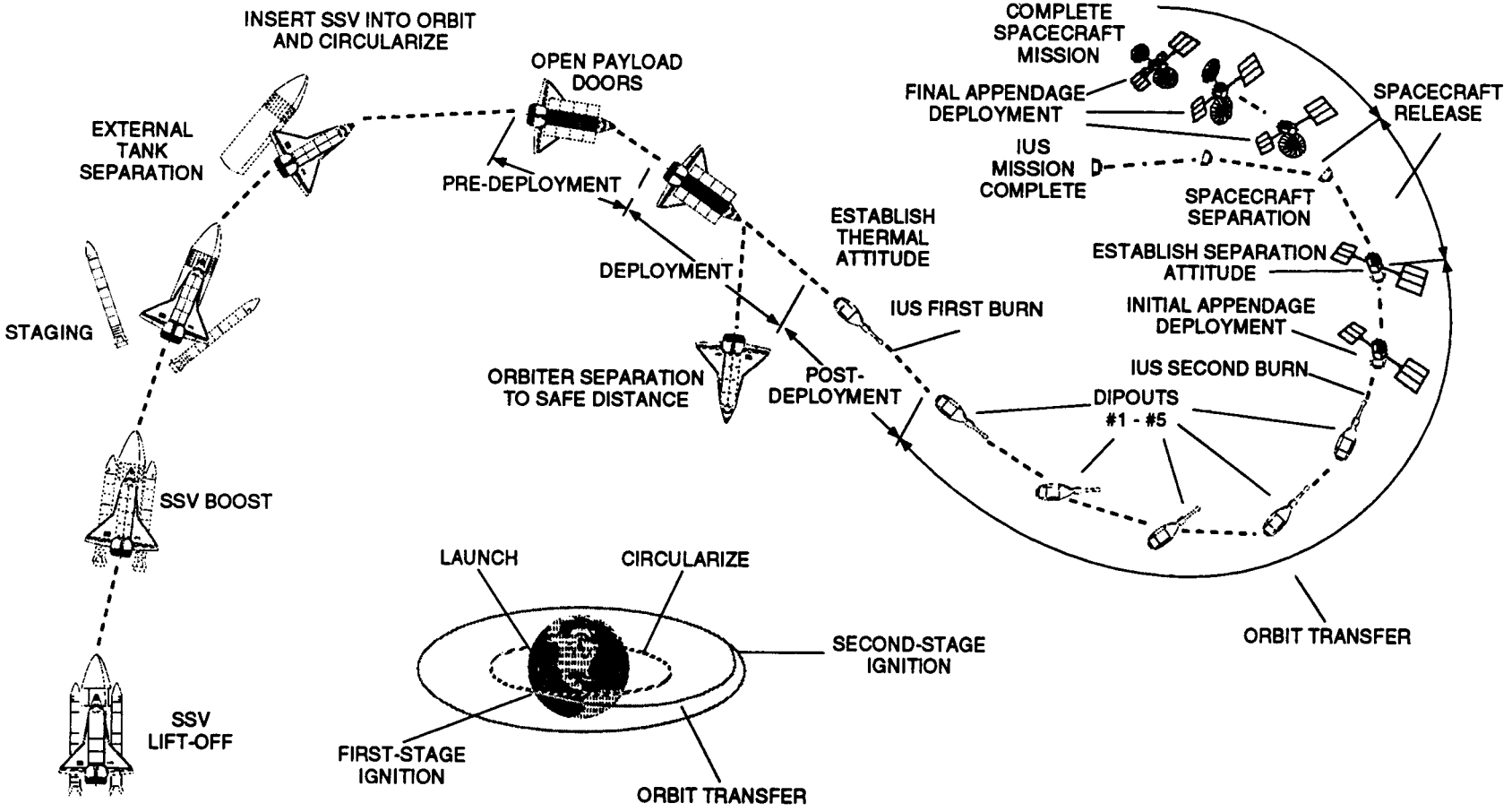
TDRS is three-axis stabilized with the multiple access body, fixed antennas pointing constantly at the Earth while the solar arrays track the sun.

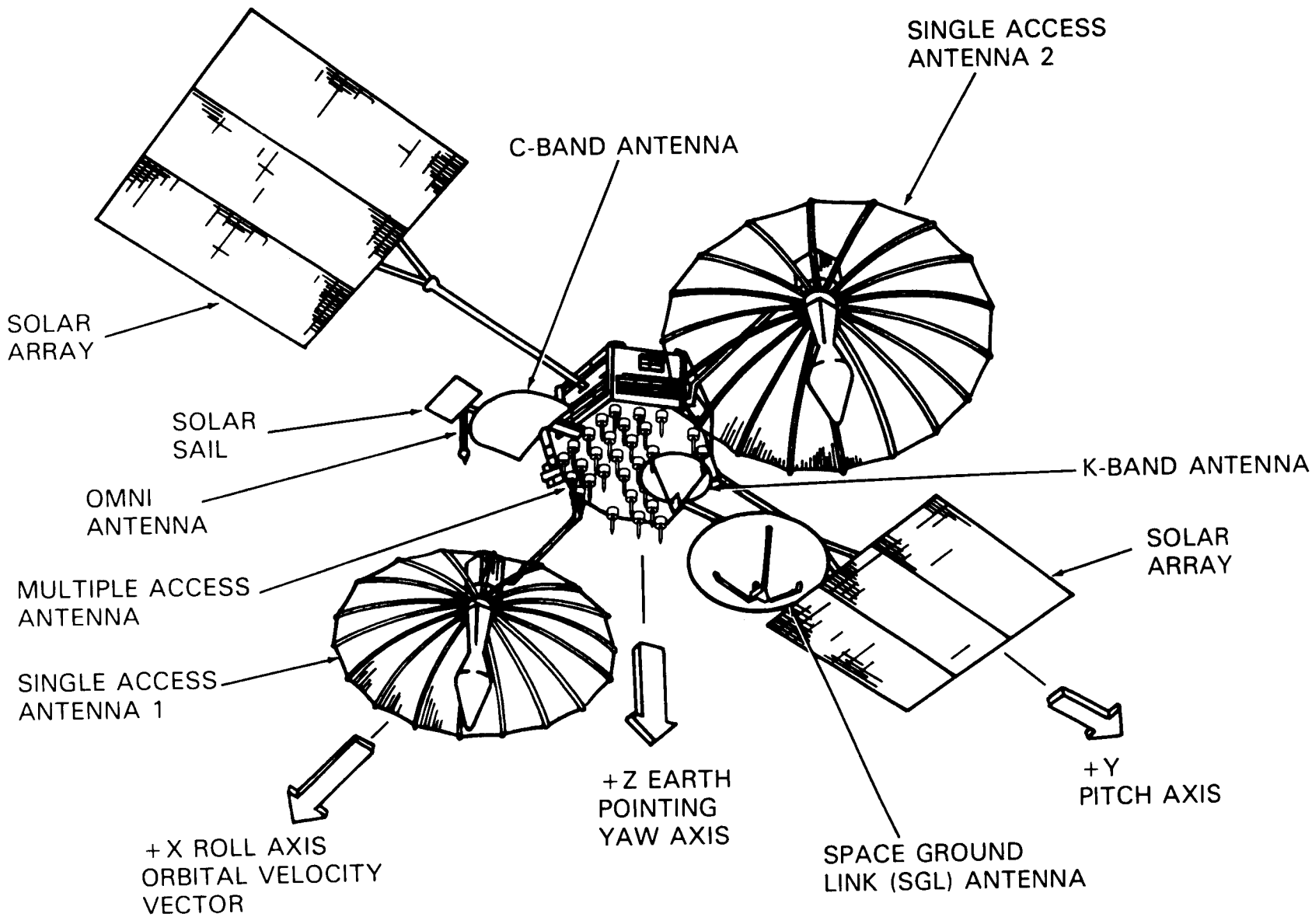
Communication System

TDRS satellites do not process customer traffic in either direction. Rather, they operate as "bent pipe" repeaters, relaying signals and data between the user spacecraft and the ground terminal and vice versa.

Nominally, the TDRSS is intended to meet the requirements of up to 24 customer spacecraft, including the Space Shuttle, simultaneously. It provides two types of service: multiple access which can relay data from as many as 20 low data rate (100 bits per second to 50 kilobits per second) customer satellites simultaneously and single access antennas which provide two high data rate channels to 300 megabits per second from both the east and west locations.

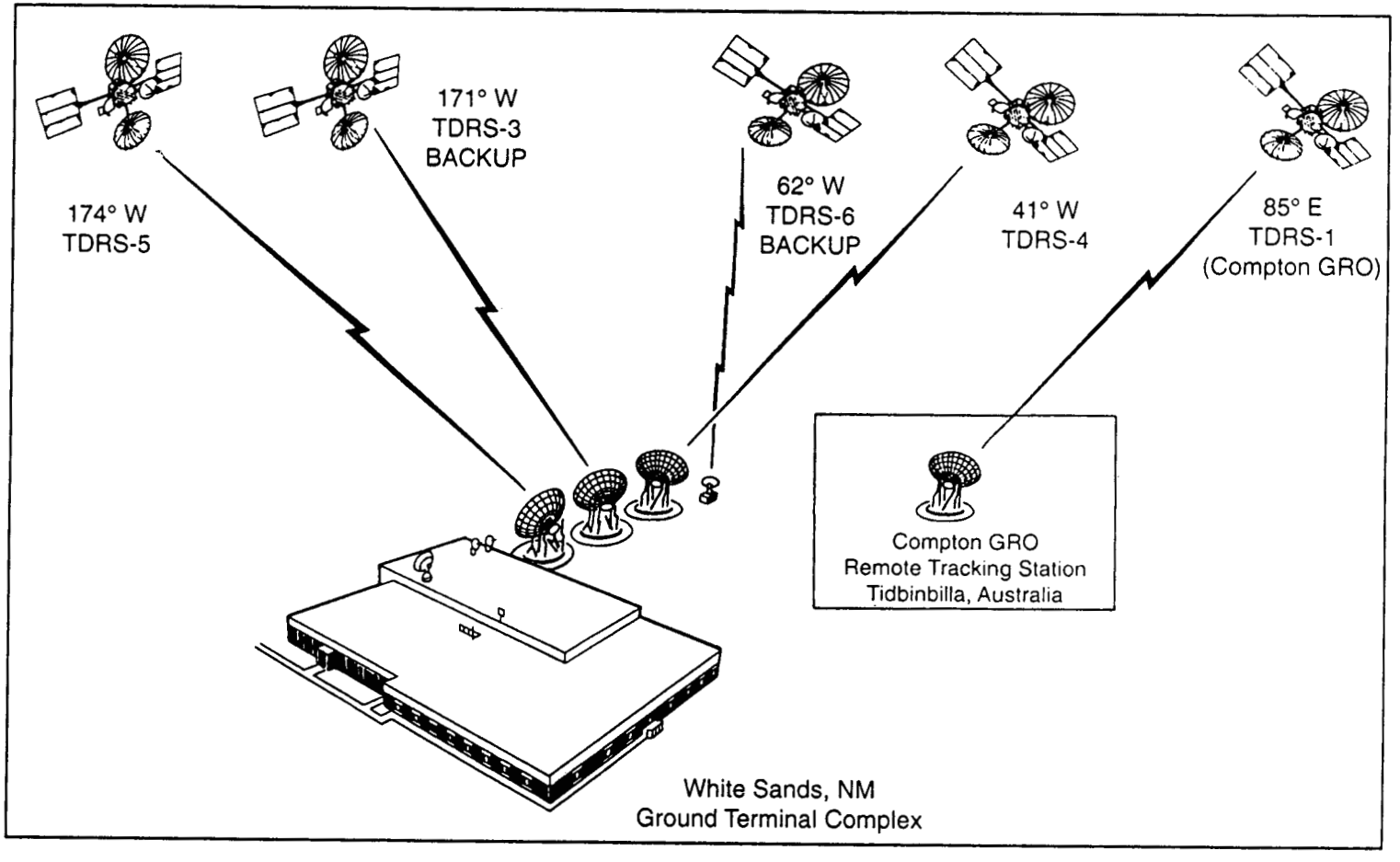
TDRS Deployment Sequence





TDRS SPACECRAFT ON-ORBIT CONFIGURATION

WITH FIVE SATELLITES - 1993



The White Sands Ground Terminal (WSGT) provides a location with a clear line-of-sight to the TDRSs and a place where rain conditions have limited interference with the availability of the Ku-band uplink and downlink channels. The WSGT is operated for NASA by GTE Government Systems Corp., Needham Heights, Mass.

Co-located at White Sands is the NASA Ground Terminal operated by Bendix Field Engineering Corp., Columbia, Md. This terminal provides the interface between WSGT and other primary network elements located at NASA's Goddard Space Flight Center, Md.

Facilities at GSFC include the Network Control Center (NCC) which provides system scheduling and is the focal point for NASA communications and the WSGT and TDRSS users; the Flight Dynamics Facility which provides the network with antenna pointing information for user spacecraft and the TDRSs and the NASA Communications Network (NASCOM) which provides the common carrier interface through Earth terminals at Goddard, White Sands and the Johnson Space Center, Houston.

The NCC console operators monitor network performances, schedule emergency interfaces, isolate faults in the system, account for system use, test the system and conduct simulations.

The user services available from the space network are provided through NASCOM, a global system providing operational communications support to all NASA projects. NASCOM offers voice, data and teletype links with the space network, the Ground Spaceflight Tracking and Data Network and the user spacecraft control centers.

NASA's Office of Space Communications, Washington, D.C., has overall management responsibility of these tracking, data acquisition and communications facilities.

TDRS Components

TDRSs are composed of three distinct modules -- an equipment module, a communications payload module and an antenna module. The modular design reduces the cost of individual design and construction efforts that, in turn, lower the cost of each satellite.

The equipment module housing the subsystems that operate the satellite is located in the lower hexagon of the spacecraft. The attitude control subsystem stabilizes the satellite to provide accurate antenna pointing and proper orientation of the solar panels to the sun. The electrical power subsystems consists of two solar panels that provide a 10-year power supply of approximately 1,700 watts. The thermal control subsystem consists of surface coatings and controlled electric heaters.

The payload module is composed of the electronic equipment required to provide communications between the user spacecraft and the ground.

The receivers and transmitters for single access services are mounted in compartments on the back of the single-access antennas.

The antenna module is composed of seven antenna systems: two single-access, the multiple access array, space-to-ground link and the S-band omni for satellite health and housekeeping. Commercial K-band and C-band antennas round out the complement.

For single-access service, the TDRSs have dual-feed S-band, Ku-band parabolic (umbrella-like) antennas. These antennas are free to be positioned in two axis, directing the radio beam to orbiting user spacecraft below. These antennas primarily relay communications to and from user spacecraft. The high data rates provided by these antennas are available to users on a time-shared basis. Each antenna is capable of supporting two user spacecraft services simultaneously -- one at S-band and one at Ku-band-provided both users are within the beam width of the antenna.

The multiple access antenna array is hard-mounted in one position on the surface of the antenna module facing the Earth Another antenna, a 6.5-foot (2-meter) parabolic reflector, provides the prime link for relaying transmissions to and from the ground terminal at Ku-band.

Project Support

TRW Space & Electronics Group, Redondo Beach, Calif., is the prime spacecraft contractor. Ground operations at the White Sands complex are conducted by GTE Government Systems Corp., Needham Heights, Mass., and Bendix Field Engineering Corp., Columbia, Md.

INERTIAL UPPER STAGE (IUS)

The Inertial Upper Stage (IUS) will be used with the Space Shuttle to transport NASA's sixth Tracking and Data Relay Satellite (TDRS-F) to geosynchronous orbit, some 22,300 statute miles (35,880 km) from Earth.

Background

The IUS was originally designed as a temporary stand-in for a reusable space tug, and the IUS was named the Interim Upper Stage. The word "Inertial" (signifying the guidance technique) later replaced "Interim" when it was determined that the IUS would be needed through the 1990's. In addition to the TDRS missions, the IUS was utilized for the Magellan, Galileo and Ulysses planetary missions.

The IUS was developed and built under contract to the Air Force Systems Command's Space Division. The Space Division is executive agent for all Department of Defense activities pertaining to the Space Shuttle system and provides the IUS to NASA for Space Shuttle use. Boeing Aerospace Company, Seattle, was selected in August 1976 to build the IUS.

Specifications

IUS-13, to be used on mission STS-54, is a two-stage rocket. Each stage has a solid rocket motor, preferred over liquid-fueled engines for their relative simplicity, high reliability, low cost and safety.

The IUS is 17 feet (5.18 meters) long and 9.25 feet (2.8 m) in diameter. It consists of an aft skirt; an aft stage solid rocket motor containing 21,400 pounds (9,707 kg) of propellant generating approximately 42,000 pounds (188,496 newtons) of thrust; an interstage; a forward stage solid rocket motor with 6,000 pounds (2,722 kg) of propellant generating approximately 18,000 pounds (80,784 newtons) of thrust and an equipment support section.

The equipment support section contains the avionics which provide guidance, navigation, control, telemetry, command and data management, reaction control and electrical power. All mission-critical components of the avionics system, along with thrust vector actuators, reaction control thrusters, motor igniter and pyrotechnic stage separation equipment are redundant to assure reliability of better than 98 percent.

Airborne Support Equipment

The IUS Airborne Support Equipment (ASE) is the mechanical, avionics, and structural equipment located in the orbiter. The ASE supports the IUS and the TDRS-F in the orbiter payload bay and elevates the IUS/TDRS for final checkout and deployment from the orbiter.

The IUS ASE consists of the structure, aft tilt frame actuator, batteries, electronics and cabling to support the IUS/TDRS combination. These ASE subsystems enable the deployment of the combined vehicle; provide, distribute and/or control electrical power to the IUS and satellite and serve as communication conduits between the IUS and/or satellite and the orbiter.

IUS Structure

The IUS structure is capable of supporting the loads generated internally and also by the cantilevered spacecraft during orbiter operations and the IUS free flight. In addition, the structure physically supports all the equipment and solid rocket motors within the IUS, and provides the mechanisms for IUS stage separation. The major structural assemblies of the two-stage IUS are the equipment support section, interstage and aft skirt. It is made of aluminum skin-stringer construction with longerons and ring frames.

Equipment Support Section

The Equipment Support Section houses the majority of the IUS avionics. The top of the equipment support section contains the spacecraft interface mounting ring and electrical interface connector segment for mating and integrating the spacecraft with the IUS. Thermal isolation is provided by a

multilayer insulation blanket across the interface between the IUS and TDRS.

IUS Avionics Subsystems

The avionics subsystems consist of the telemetry, tracking and command subsystems; guidance and navigation subsystem; data management; thrust vector control and electrical power subsystems. These subsystems include all electronic and electrical hardware used to perform all computations, signal conditioning, data processing and formatting associated with navigation, guidance, control, data and redundancy management. The IUS avionics subsystems also provide the equipment for communications with the orbiter and ground stations as well as electrical power distribution.

Attitude control in response to guidance commands is provided by thrust vectoring during powered flight and by reaction control thrusters while coasting.

Attitude is compared with guidance commands to generate error signals. During solid motor firing, these commands gimble the IUS's movable nozzle to provide the desired attitude pitch and yaw control. The IUS's roll axis thrusters maintain roll control. While coasting, the error signals are processed in the computer to generate thruster commands to maintain the vehicle's altitude or to maneuver the vehicle.

The IUS electrical power subsystem consists of avionics batteries, IUS power distribution units, power transfer unit, utility batteries, pyrotechnic switching unit, IUS wiring harness and umbilical, and staging connectors. The IUS avionics system distributes electrical power to the IUS/TDRS interface connector for all mission phases from prelaunch to spacecraft separation.

IUS Solid Rocket Motors

The IUS uses a large and a small solid rocket motor employing movable nozzles for thrust vector control. The nozzles provide up to 4 degrees of steering on the large motor and 7 degrees on the small motor. The large motor is the longest thrusting duration solid rocket motor ever developed for space, with the capability to thrust as long as 150 seconds. Mission requirements and constraints (such as weight) can be met by tailoring the amount of solid propellant carried.

Reaction Control System

The reaction control system controls the IUS/TDRS's attitude during coasting; roll control during SRM thrustings and velocity impulses for accurate orbit injection.

As a minimum, the IUS includes one reaction control fuel tank with a capacity of 120 pounds (54.4 kg) of hydrazine. Production options are

available to add a second or third tank. IUS-13 will carry two tanks, each with 120 pounds (54.4 kg) of fuel.

To avoid spacecraft contamination, the IUS has no forward facing thrusters. The reaction control system also provides the velocities for spacing between several spacecraft deployments and for avoiding collision or contamination after the spacecraft separates.

IUS-to-Spacecraft Interfaces

The TDRS spacecraft is physically attached to the IUS at eight attachment points, providing substantial load-carrying capability while minimizing the transfer of heat across the connecting points. Power, command and data transmission between the two are provided by several IUS interface connectors.

In addition, the IUS provides an insulation blanket of multiple layers of double-aluminized Kapton and polyester net spacers across the IUS/TDRS interface. The outer layer of the blanket, facing the TDRS spacecraft, is a special Teflon-coated fabric called Beta cloth. The blankets are vented toward and into the IUS cavity, which in turn is vented to the orbiter payload bay. There is no gas flow between the spacecraft and the IUS. The thermal blankets are grounded to the IUS structure to prevent electrostatic charge buildup.

Flight Sequence

After the orbiter payload bay doors are opened in orbit, the orbiter will maintain a preselected attitude to keep the payload within thermal requirements and constraints.

On-orbit predeployment checkout begins, followed by an IUS command link check and spacecraft communications command check. Orbiter trim maneuvers normally are performed at this time.

Forward payload restraints will be released and the aft frame of the airborne support equipment will tilt the IUS/TDRS to 29 degrees. This will extend the TDRS into space just outside the orbiter payload bay, allowing direct communication with Earth during systems checkout. The orbiter will then be maneuvered to the deployment attitude. If a problem has developed within the spacecraft or IUS, the IUS and its payload can be restowed.

Prior to deployment, the spacecraft electrical power source will be switched from orbiter power to IUS internal power by the orbiter flight crew. After verifying that the spacecraft is on IUS internal power and that all IUS/TDRS predeployment operations have been successfully completed, a GO/NO-GO decision for IUS/TDRS deployment will be sent to the crew.

When the orbiter flight crew is given a GO decision, they will activate the pyrotechnics that separates the IUS/TDRS umbilical cables. The crew will

then command the electromechanical tilt actuator to raise the tilt table to a 58-degree deployment position.

The orbiter's RCS thrusters will be inhibited and a pyrotechnic separation device initiated to physically separate the IUS/spacecraft combination from the tilt table. Compressed springs provide the force to jettison the IUS/TDRS from the orbiter payload bay at approximately 0.10 meters (4.2 inches) per second. The deployment is normally performed in the shadow of the orbiter or in Earth eclipse.

The tilt table will be lowered to minus 6 degrees after IUS and its spacecraft are deployed. Approximately 19 minutes after IUS/TDRS deployment, the orbiter's engines will be ignited to move the orbiter away from the IUS/TDRS.

At this point, the IUS/TDRS is controlled by the IUS onboard computers. Approximately 10 minutes after the IUS/TDRS is ejected from the orbiter, the IUS onboard computer will send out signals used by the IUS and/or TDRS to begin mission sequence events. This signal also will enable the reaction control system. All subsequent operations will be sequenced by the IUS computer, from transfer orbit injection through spacecraft separation and IUS deactivation.

After the RCS has been activated, the IUS will maneuver to the required thermal attitude and perform any required spacecraft thermal control maneuvers.

At approximately 45 minutes after ejection from the orbiter, the pyrotechnic inhibits for the first solid rocket motor will be removed. The belly of the orbiter has been oriented towards the IUS/TDRS combination to protect the orbiter windows from the IUS's plume. The IUS will recompute the first ignition time and maneuvers necessary to attain the proper attitude for the first thrusting period.

When the proper transfer orbit opportunity is reached, the IUS computer will send the signal to ignite the first stage motor. This is expected at approximately 60 minutes after deployment (L+7 hours, 13 minutes). After firing approximately 146 seconds and prior to reaching the apogee point of its trajectory, the IUS first stage will expend its fuel. While coasting, the IUS will perform any maneuvers needed by TDRS for thermal protection or communications. When this is completed, the IUS first stage and interstage will be separated from the IUS second stage.

Approximately 6 hours, 12 minutes after deployment at approximately L+12:30, the second stage motor will be ignited, thrusting for about 108 seconds. After burn is complete, the IUS stabilizes the TDRS while the solar arrays and two antennas are deployed. The IUS second stage will separate and perform a final collision/contamination avoidance maneuver before deactivating.

DIFFUSE X-RAY SPECTROMETER (DXS)

The Diffuse X-ray Spectrometer (DXS) addresses a fundamental question of present-day astrophysics -- what is the origin and nature of the interstellar medium, the matter that fills the space between stars?

The DXS will study the hottest components of the interstellar medium, gases at temperatures at approximately 1 million degrees Kelvin, by detecting the x-rays emitted there. By measuring the gas temperature and composition, the DXS will provide important clues to the origin, evolution and physical state of this constituent of the Milky Way galaxy.

The hot interstellar medium is one phase in the life cycle of the material in this galaxy. By studying this life cycle, the DXS scientists hope to learn more about the way the mass and energy of the galaxy are redistributed as it evolves. A better understanding of the evolution of the galaxy is one of the steps toward understanding the nature and evolution of galaxies, which contain most of the visible matter in the Universe.

The DXS, developed by the University of Wisconsin, Madison, consists of two identical instruments, one mounted to each side of the Shuttle cargo bay. A DXS instrument consists of a detector, its associated gas supply and electronics. Each instrument is mounted to a 200-pound (91-kg) plate, which is attached to the side of the Shuttle bay.

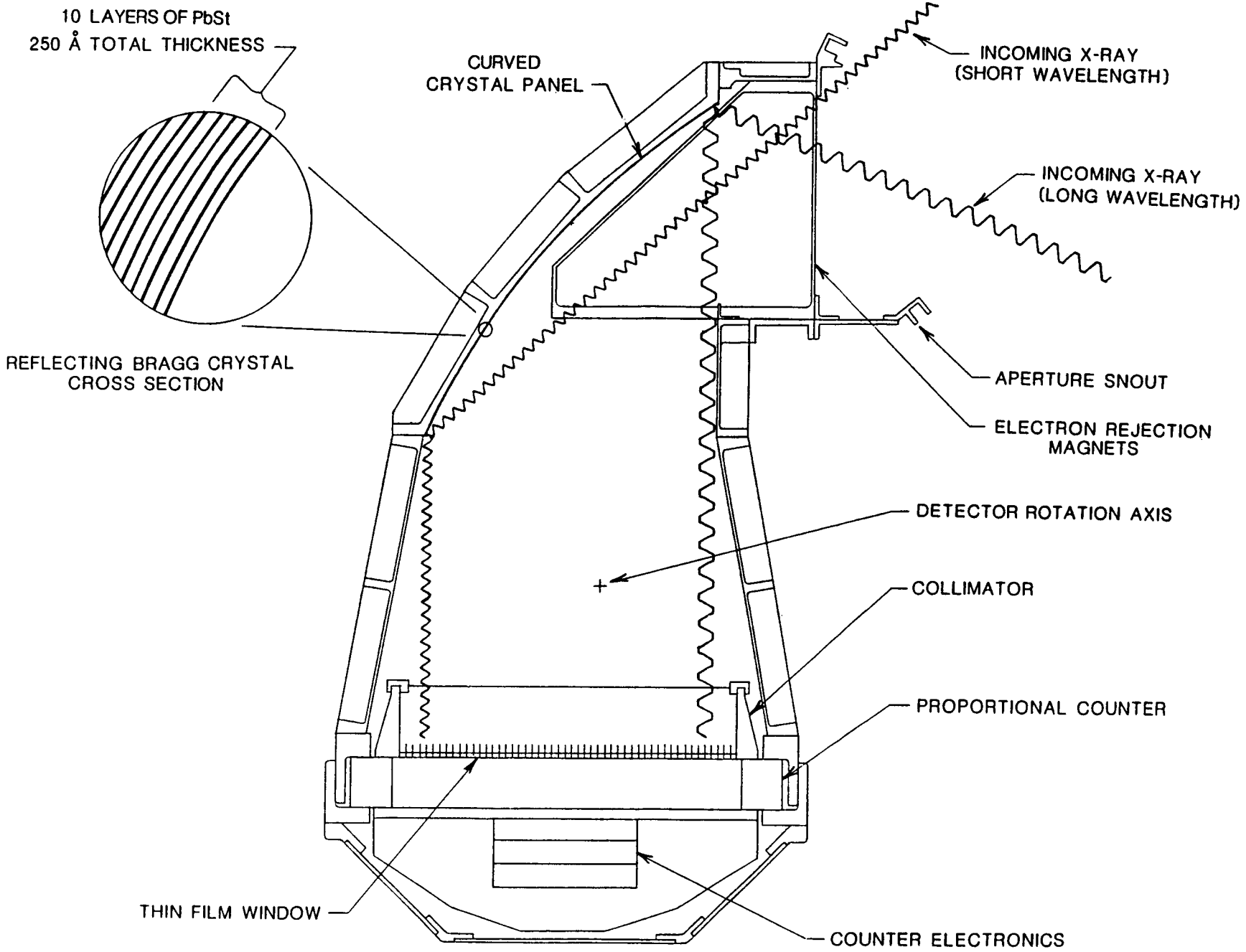
These plates are part of the Goddard Space Flight Center's Shuttle Payload of Opportunity Carrier (SPOC) standard hardware, which is part of the Hitchhiker carrier system.

The Hitchhiker system provides real-time communications between the payload and customers in the Hitchhiker control center at Goddard Space Flight Center, Greenbelt, Md. The carrier system is modular and expandable in accordance with payload requirements. Hitchhikers were created to provide a quick reaction and low-cost capability for flying small payloads in the Shuttle payload bay.

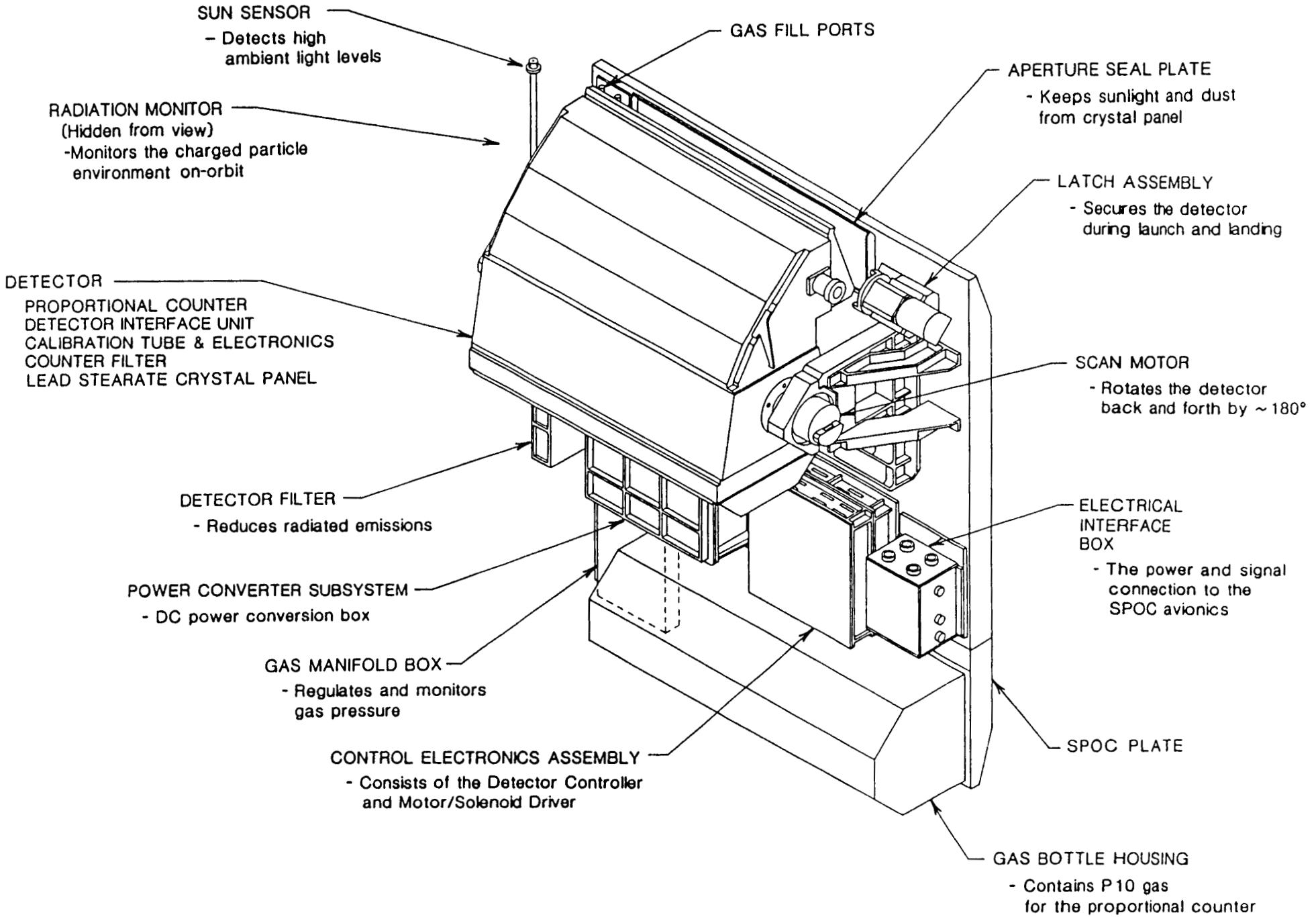
DXS Science

A large percentage of x-rays from space do not originate from specific objects like stars or galaxies, but from some source that appears to be distributed over the entire sky. Astronomers have found that these emissions fall into two types: high-energy or "hard" x-rays that may be the unresolved emissions from a collection of distant galaxies and low-energy or "soft" x-rays that are not yet well understood. DXS will study the latter.

Because low energy x-rays cannot travel more than a few hundred light years in interstellar space before they are absorbed, most of the diffuse soft x-ray background observed must have originated in the Milky Way galaxy from the vicinity of Earth's solar system.



DXS DETECTOR ASSEMBLY


SUN SENSOR
– Detects high ambient light levels
RADIATION MONITOR
(Hidden from view)
-Monitors the charged particle environment on-orbit
DETECTOR
PROPORTIONAL COUNTER
DETECTOR INTERFACE UNIT
CALIBRATION TUBE & ELECTRONICS
COUNTER FILTER
LEAD STEARATE CRYSTAL PANEL
DETECTOR FILTER
- Reduces radiated emissions
POWER CONVERTER SUBSYSTEM
- DC power conversion box
GAS MANIFOLD BOX
- Regulates and monitors gas pressure
CONTROL ELECTRONICS ASSEMBLY
- Consists of the Detector Controller and Motor/Solenoid Driver
GAS FILL PORTS
APERTURE SEAL PLATE
- Keeps sunlight and dust from crystal panel
LATCH ASSEMBLY
- Secures the detector during launch and landing
SCAN MOTOR
- Rotates the detector back and forth by ~180°
ELECTRICAL INTERFACE BOX
- The power and signal connection to the SPOC avionics
SPOC PLATE
GAS BOTTLE HOUSING
- Contains P10 gas for the proportional counter

The DXS measures the arrival direction and wavelength of incident low energy x-rays in the wavelength range of 42 to 84 angstroms -- an angstrom is one ten-thousandth of a millimeter. From this information, the DXS scientists will be able to determine the spectrum (brightness at each wavelength) of the diffuse soft x-ray background from each of several regions of the sky.

By analyzing these spectral features, scientists can identify the temperature, the ionization state and the elements which constitute this plasma. From these data they can tell whether the plasma is young and heated in the last 100,000 years or old and heated millions of years ago.

Previous experiments were not capable of measuring the spectrum of the diffuse soft x-ray background. With its spectral determination capability, the DXS will make this type of measurement possible for the first time.

DXS Operations

Once the Shuttle is on orbit and the payload bay doors are open, a crew member will activate the experiment. DXS will be operated from Goddard's Payload Operations Control Center (POCC). University of Wisconsin personnel at Goddard will control and monitor the DXS, and Goddard personnel will monitor and control the operations of the Hitchhiker carrier support hardware.

The DXS instruments will collect x-ray data during approximately 64 orbital nights over 4 flight days. In the orbit day periods throughout the mission, the DXS will perform sensor calibrations and will periodically replenish the detectors' gas supply. Goddard's Flight Dynamics Facility and the Spacelab Data Processing Facility will assist the DXS POCC operations and data processing activities.

After the Shuttle lands, the DXS instruments will be transported to the University of Wisconsin for post-flight testing and calibration.

DXS History

The DXS investigation was proposed and selected in response to a 1978 announcement of opportunity to conduct scientific investigations aboard the Space Shuttle. NASA selected DXS and four other astrophysics investigations, including three ultraviolet instruments and one x-ray telescope that flew in December 1990 on the STS-35/Astro-1 mission. All have scientific objectives and requirements that can be accomplished in a 5-10 day Shuttle mission.

DXS was originally manifested to fly with the Broad Band X-ray Telescope (BBXRT) on the second Shuttle High Energy Astrophysics Laboratory flight. In the re-manifesting that followed the Challenger accident, BBXRT flew on Astro-1, and DXS moved to STS-54.

STS-54 EVA TEST OBJECTIVE

On the fifth day of the STS-54 flight, Mission Specialists Greg Harbaugh and Mario Runco, Jr., will perform the first in a series of test spacewalks to be conducted on Shuttle missions during the years leading up to the construction of Space Station Freedom, scheduled to begin in early 1996.

Harbaugh will be designated Extravehicular Crew Member 1 (EV1) and Runco will be EV2. Mission Specialist Susan Helms will assist with the spacewalk from inside Endeavour's cabin as the intravehicular activity crew member (IV), tracking the progress of Harbaugh and Runco as they move through various tasks in the cargo bay.

The spacewalk tests are designed to refine training methods for future spacewalks, expand the experience of ground controllers, instructors and astronauts and aid in better understanding the differences between true weightlessness and the underwater facility used to train crew members.

During the STS-54 spacewalk, Runco and Harbaugh will evaluate how well they adapt to spacewalking, test their abilities to move about the cargo bay with and without carrying items, test the ability to climb into a foot restraint without handholds and test their ability to align a large object in weightlessness.

The spacewalk is the lowest priority test being performed on STS-54. No extra cargo has been added to the flight for the test, and it will not have any impact on the other payloads aboard Endeavour.

To simulate carrying a large object, the astronauts will carry one another: to evaluate how well large tools can be used, they will work with a tool already aboard Endeavour designed to manually raise the tilt table for the Tracking and Data Relay Satellite's Inertial Upper Stage booster; to simulate how well they can align an object, they will attempt to place each other into the brackets in Endeavour's airlock that hold the spacesuit backpacks when not in use.

Flight controllers expect many of these tasks to be awkward for the spacewalkers, and finding out just how difficult they will be is one goal of the tests. Information from this spacewalk test will be combined with information from many more that will follow to refine the understanding of difficulties involved with spacewalk work.

DEVELOPMENTAL AND PHYSIOLOGICAL PROCESSES INFLUENCING SEED PRODUCTION IN MICROGRAVITY (CHROMEX-4)

Principal Investigator Dr. Mary Musgrave, Louisiana State University

CHROMEX-4 is designed to gain an understanding of the reproductive abnormalities which apparently occur in plants exposed to microgravity, and to determine whether changes in developmental processes may be due to spaceflight conditions, especially microgravity. This experiment also will

help understanding how gravity influences fertilization and development on Earth.

To date, only a few studies have been conducted on developing seeds in space, and they all showed very poor seed production. NASA would like to use plants as a source of food and atmospheric cleansing for astronauts staying in space for extended periods of time. Seed production is vital if crops like wheat and rice are to be utilized for food.

The effects of microgravity on the seed production of Arabidopsis thaliana will be studied. Arabidopsis thaliana is a small, cress-type plant with white flowers. Its small size, small genome and short life cycle (45 days) make it ideal for gene mapping studies. It was chosen because it is small enough to fit in the flight hardware, and its rapid life cycle and numerous flowers will ensure that a maximum number of reproductive stages can be observed in a limited number of plants. Arabidopsis seeds will be planted preflight so that 14-day-old plants, capable of producing seeds, can be flown.

These plants will be flown inside the Plant Growth Unit (PGU), a closed system that provides day/night lighting located in the orbiter middeck. The PGU will hold six Plant Growth Chambers (PGC's), each of which will contain six plants. The PGC's provide structural and nutritional support to the plants while on orbit.

The PGU replaces one standard middeck locker and requires 28 volts of power from the orbiter. This hardware provides lighting, limited temperature control and data acquisition for post-flight analysis. The PGU has previously flown on STS-3, -51F, -29 and -41.

Following the flight, the flowers and developing seeds will be preserved and their structures will be subjected to gross morphological and histological analysis to determine the locations and life cycle stages of reproductive abnormality. These structures will be examined in detail by electron-microscopy.

The remaining plant tissue also will be analyzed for soluble carbohydrate, starch and chlorophyll. Sections of roots and leaves would examine other physiological processes that might be affected as a result of exposure to microgravity. All data will be compared with data gathered from 1g ground controls conducted at a later date using identical hardware.

Dr. Mary Musgrave of Louisiana State University is the Principal Investigator. The experiment is sponsored by the Life Sciences Division of NASA's Office of Space Science and Application. The experiment is managed by the Kennedy Space Center.

COMMERCIAL GENERIC BIOPROCESSING APPARATUS (CGBA)

The Commercial Generic Bioprocessing Apparatus (CGBA) payload is sponsored by NASA's Office of Advanced Concepts and Technology and is developed by BioServe Space Technologies, a NASA Center for the Commercial Development of Space (CCDS) at the University of Colorado, Boulder. The purpose of the CGBA is to allow a wide variety of sophisticated biomaterials, life sciences and biotechnology investigations to be performed in one apparatus in the microgravity environment.

Commercial Investigations

During the STS-54 mission, the CGBA will support 28 separate commercial investigations, loosely classified in three application areas: biomedical testing and drug development, controlled ecological life support system (CELSS) and agricultural development and manufacture of biological-based materials.

Biomedical Testing and Drug Development: To collect information on how microgravity affects biological organisms, the CGBA will include 12 biomedical test models. Of the 12 test models, five are related to immune disorders.

One will investigate the process in which certain cells engulf and destroy foreign materials (phagocytosis); another will study bone marrow cell cultures; two others will study the ability of the immune system to respond to infectious-type materials (lymphocyte and T-cell induction) and one will investigate the ability of immune cells to kill infectious cells (TNF-Mediated Cytotoxicity).

The other seven test models -- which are related to bone and developmental disorders, wound healing, cancer and cellular disorders -- will investigate bone tissue formation, brine shrimp development, pancreas and lung development, tissue regeneration, inhibition of cell division processes, stimulation of cell division processes and the ability of protein channels to pass materials through cell membranes.

Test model results will provide information to better understand diseases and disorders that affect human health, including cancer, osteoporosis and AIDS. In the future, these models may be used for the development and testing of new drugs to treat these diseases.

CELSS Development: To gain knowledge on how microgravity affects micro-organisms, small animal systems, algae and higher plant life. The CGBA will include 10 ecological test systems. Four test systems will examine miniture wasp and fruit fly development, seed germination and seedling processes for CELSS studies.

Another four test systems will investigate bacterial products and processes and bacterial colonies for waste management applications. Two

other systems (Triiodid and Zirconium Peroxide) will study new materials to control build-up of unwanted bacteria and other micro-organisms.

Test system results will provide research information with many commercial applications. For example, evaluating higher plant growth in microgravity could lead to new commercial opportunities in controlled agriculture applications. Test systems that alter micro-organisms or animal cells to produce important pharmaceuticals later could be returned to Earth for large-scale production. Similarly, it may be possible to manipulate agricultural materials to produce valuable seed stocks.

Biomaterials Products and Processes: The CGBA also will be used to investigate six different biomaterials products and processes. Two investigations will attempt to grow large protein and RNA crystals to yield information for use in commercial drug development. A third investigation will evaluate the assembly of virus shells for use in a commercially-developed drug delivery system.

Another investigation will attempt to form a homogenous matrix of special light-sensitive biological molecules called bacteriorhodopsin. Such a matrix may be used in novel electronic mass storage systems associated with computers. A fifth experiment will use bacteria to form magnetosomes (tiny magnets) for potential use in advanced electronics. A sixth investigation will use fibrin clot materials as a model of potentially implantable materials that could be developed commercially as replacements for skin, tendons, blood vessels and even cornea.

Results from the 28 investigations will be considered in determining subsequent steps toward commercialization. STS-54 marks the second of six CGBA flights. Future flights will continue to focus on selecting and developing investigations that show the greatest commercial potential.

Commercial Generic Bioprocessing Apparatus (CGBA) Experiments

Experiment	PI Affiliation	Experiment Description	Commercial Application
Lymphocyte Induction Process	U. of Alabama in Huntsville	Examines immune system's ability to respond to infectious-type materials.	Immune Disorders
T-Cell Induction Test Model	Kansas State U.	Examines immune system's ability to respond to infectious-type materials.	Immune Disorders
TNF-Mediated Cytotoxicity Test Model	Kansas State U.	Examines immune cells' ability to kill infectious cells.	Immune Disorders
Bone Marrow Cell Culture Test System	Kansas State U.	Studies bone marrow cultures in microgravity.	Immune Disorders
Phagocytosis Process Testing	U. of Rochester	Investigates process in which certain cells engulf and destroy foreign materials.	Immune Disorders
Bone Organ Culture Test Model	Kansas State U.	Studies bone tissue formation in microgravity.	Bone Disorders
Pancreas and Lung Development Tests	Kansas State U.	Examines lung and pancreas development in microgravity.	Developmental Disorders
Regeneration Test Model	Spaceport Florida	Investigates tissue regeneration in microgravity.	Wound Healing Testing
Brine Shrimp Test System	Kansas State U.	Examines brine shrimp development in microgravity.	Developmental Disorders
Inhibitor Protein Test Model	Kansas State U.	Studies inhibition of cell division processes.	Cancer
Gap Junction Processes	Kansas State U.	Investigates ability of protein channels to pass materials through cell membranes.	Cellular Disorders
Cell Division Processes	U. of Colorado	Studies stimulation of cell division processes.	Cellular Disorders
Seed Germination Products	U. of Colorado	Studies seed germination in microgravity.	Controlled Ecological Life Support System (CELSS) Studies
Seedling Processes	Kansas State U.	Examines seedling processes in microgravity.	CELSS Studies
Miniature Wasp Test System	U. of Colorado	Investigates miniature wasp development in microgravity.	CELSS Studies

Commercial Generic Bioprocessing Apparatus (CGBA) Experiments

Experiment	PI Affiliation	Experiment Description	Commercial Application
Fruit Fly Test System	Kansas State U.	Examines fruit fly development in microgravity.	CELSS Studies
Bacterial Products and Processes	U. of Colorado	Studies bacterial products, processes and colonies in microgravity.	Waste Management
Bacterial Products and Processes	Kansas State U.	Studies bacterial products, processes and colonies in microgravity.	Waste Management
Bacterial Products and Processes	Kansas State U.	Studies bacterial products, processes and colonies in microgravity.	Waste Management
Bacterial Colony Test System	U. of Colorado	Studies bacterial products, processes and colonies in microgravity.	Waste Management
Triiodid Product Testing	U. of Colorado	Investigates new materials to control build-up of unwanted bacteria and other micro-organisms.	Microbial Control
Zirconium Peroxide Product Testing	Kansas State U.	Investigates new materials to control build-up of unwanted bacteria and other micro-organisms.	Microbial Control
Virus Capsid Product	Kansas State U.	Evaluates assembly of virus shells.	Drug Delivery System
Protein Crystal Morphology Products	U. of Colorado	Growth of large protein crystals.	Drug Development
RNA Crystal Growth Products	U. of Colorado	Growth of large RNA crystals.	Drug Development
Bacteriorhodopsin Biomatrix Products	Syracuse U.	Formation of homogenous matrix using special light-sensitive biological molecules.	Data Mass Storage
Magnetosome Assembly Processes	U. of Colorado	Formation of magnetosomes (tiny magnets) using bacteria.	Advanced Electronics
Fibrin Clot Materials	U. of Colorado	Use of fibrin clot materials as a model of potentially implantable materials.	Synthetic Implants

Flight Hardware

The CGBA consists of 192 Fluids Processing Apparatuses (FPAs) and 24 Group Activation Packs (GAPs). Each GAP will house eight FPAs. The FPAs will contain biological sample materials which are mixed on-orbit to begin and end an experiment. Individual experiments will use two to 12 FPAs each.

Half of the FPAs and GAPs will be stored in the orbiter middeck in two Commercial Refrigerator Incubator Modules (CRIM). The other half will be stored in a standard stowage locker. Each CRIM holds six GAPs and will be operated at 37 degrees Celsius (98.6 degrees F. -- mammalian body temperature) to support cell culture investigations.

FPA: Sample materials are contained inside a glass barrel that has rubber stoppers to separate three chambers. For each investigation, the chambers will contain precursor, initiation and termination fluids, respectively. The loaded glass barrel will be assembled into a plastic sheath that protects the glass from breakage and serves as a second level of sample fluid containment.

The FPAs are operated by a plunger mechanism that will be depressed on-orbit, causing the chambers of precursor fluid and the stoppers to move forward inside the glass barrel. When a specific stopper reaches an indentation in the glass barrel, initiation fluid from the second chamber is injected into the first chamber, activating the biological process.

Once processing is complete, the plunger will again be depressed until the termination fluid in the third chamber is injected across the bypass in the glass barrel into the first chamber.

GAP: The GAP consists of a 4-inch diameter plastic cylinder and two aluminum endcaps. Eight FPAs will be contained around the inside circumference of the GAP cylinder. A crank extends into one end of the GAP and attaches to a metal pressure plate. By rotating the crank, the plate will advance and depress the eight FPA plungers simultaneously.

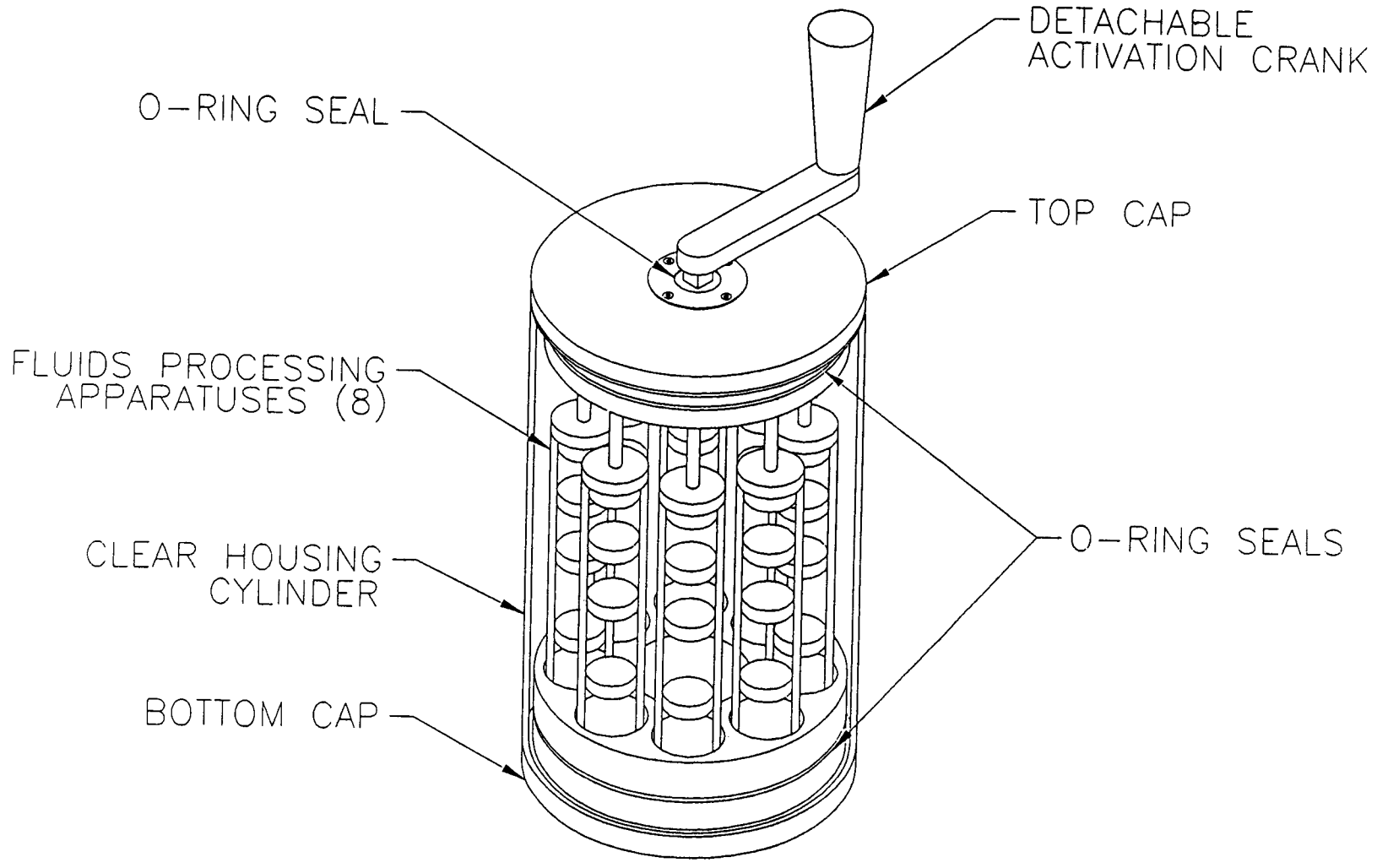
On-orbit Operations

Mission Specialists Susan Helms and Greg Harbaugh are the primary and backup crew members, respectively, responsible for CGBA operations. Upon reaching orbit, they will initiate the various investigations by attaching a crank handle to each GAP.

Turning the crank will cause an internal plate to advance and push the plungers on the contained FPAs. This action causes the fluids in the forward chambers of each FPA to mix. Most of the GAPs will be activated on either the first or second flight day.

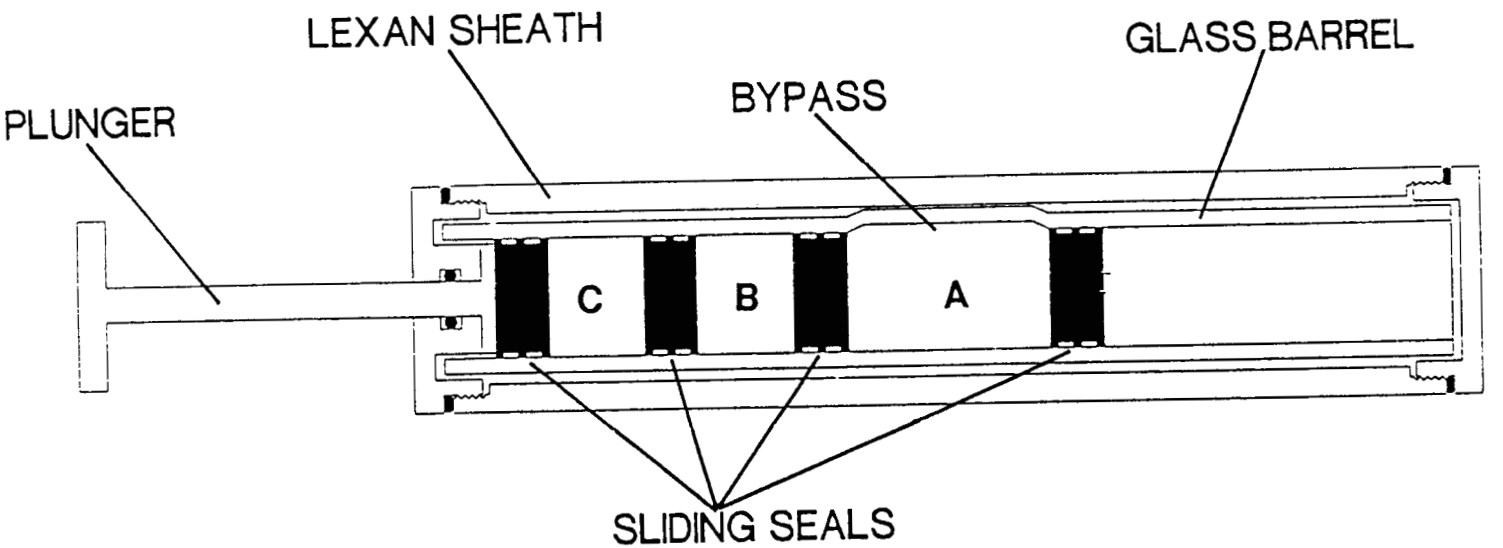
Commercial Generic Bioprocessing Apparatus

Group Activation Pack



Commercial Generic Bioprocessing Apparatus

Fluids Processing Apparatus



CHAMBER A - PRECURSOR MATERIAL

CHAMBER B - INITIATION FLUID

CHAMBER C - TERMINATION FLUID

The crew will terminate the investigations in a manner similar to activation. Attaching and turning the GAP crank will cause further depression of the FPA plungers causing the fluid in the rear chamber to mix with the processed biological materials. This fluid typically will stop the process or "fix" the sample for return to Earth in a preserved state. Each of the 24 GAPs will be terminated at different time points during the mission. In this manner, sample materials can be processed from as little as 2 hours to nearly the entire mission duration.

For most of the investigations, simultaneous ground controls will be run. Using identical hardware and sample fluids and materials, ground personnel will activate and terminate FPAs in parallel with the flight crew. Synchronization will be accomplished based on indications from the crew as to when specific GAPs are operated. A temperature controlled environment at NASA's Kennedy Space Center will be used to duplicate flight conditions.

After Endeavor has landed, the CRIMs and stowage locker will be turned over to Bioserve personnel for deintegration. Some sample processing will be performed at Kennedy. Most FPAs will be shipped or hand-carried back to the sponsoring labs for detailed analysis.

Dr. Marvin Luttges, Director of the Bioserve CCDS, is Program Manager for CGBA. Drs. Louis Stodieck and Michael Robinson, also of Bioserve, are responsible for mission management.

PHYSIOLOGICAL AND ANATOMICAL RODENT EXPERIMENT .02

Principal Investigator Kenneth M. Baldwin, Ph.D.
Department of Physiology and Biophysics
University of California, Irvine

Co-Investigator Vincent J. Caiozzo, Ph.D.
Department of Orthopaedic Surgery, College of Medicine
University of California, Irvine

The second Physiological and Anatomical Rodent Experiment (PARE.02) is a secondary payload flight experiment located in a Space Shuttle's mid-deck locker.

The goal of PARE.02 is to determine the extent to which short-term exposure to microgravity alters the size, strength and endurance capacity (stamina) of skeletal muscles normally used to help support the body against the force of gravity.

The study, managed by NASA's Ames Research Center, Mountain View, Calif., will use rodents because their muscles are known to respond rapidly to altered gravity forces.

When individuals are exposed to the microgravity of space, there appears to be a significant loss in muscle mass. This appears to be because the muscle must no longer exert a sufficient level of force, which produces a

signal to the body to conserve mass. However, the loss of muscle mass hinders one's capability to function when returning to Earth. All movement patterns are difficult, and the individual may be prone to accidents because of this instability. Scientists need to find the extent to which the muscle atrophies, what impact the atrophy process has on muscle performance and how to prevent the atrophy from occurring.

Second, the problem of muscle atrophy is similar in part to what is seen on Earth during the normal aging. As one gets older, he/she becomes less physically active and the degree of muscle disuse is exaggerated. This leads to the same problems as occur during exposure to microgravity. Thus, if the problem of atrophy in space can be solved, scientists should have a good insight for maintaining the muscle system in a more viable condition as humans age.

Millions of dollars are spent annually to treat older individuals with injuries and disabilities resulting from the general problem of muscle and bone weakness, particularly in the female population.

The information derived from such a project has obvious practical relevance to the entire health care industry. Any insight that can be generated to prevent body dysfunction and injury, as well as to rehabilitate the musculoskeletal system from the effects of disuse atrophy, are very important to the broad range population base of our society.

With the advent of the Space Shuttle program and Spacelab, it is now possible to expose both humans and animals to the unique environment of microgravity. In this way scientists can begin to partition out the specific effects of gravity in regulating the structural and functional properties of the organ systems of the body.

The Shuttle makes it possible for life to exist in a new environment that is entirely foreign to the body, thereby enabling scientists to understand how the force of gravity normally impacts health and well-being.

This is the second phase of this research experiment. The first studied the effects of microgravity on how the muscle cells process the food humans eat and transform the food into the energy necessary to enable the muscles to function. The experiment distinguished that the muscles isolated from animals exposed to zero gravity had a reduced capacity to process fat substrate while retaining a normal capacity to process carbohydrate for energy.

This finding has important implications if it occurs in the intact individual, because it would force a person to use his/her energy stores of carbohydrate at a faster rate. When this occurs the muscle loses its stamina and the individual cannot sustain physical activity for as long a time.

The PARE.02 project will examine the extent to which the muscle loses its stamina after exposure to microgravity for 6 days.

NASA's Ames Research Center provides payload and science management and support for PARE.02. The project is sponsored by the Life Sciences Division of NASA's Office of Space Science and Applications.

SOLID SURFACE COMBUSTION EXPERIMENT (SSCE)

Principal Investigator Professor Robert A. Altenkirch
Dean of Engineering, Mississippi State University

The purpose of the SSCE is to study the physical and chemical mechanisms of flame propagation over solid fuels in the absence of gravity-driven buoyant or externally-imposed airflows. The controlling mechanisms of flame propagation in microgravity are different than in normal gravity.

On Earth, gravity causes the air heated by the flame to rise. This air flow, called buoyant convention, feeds oxygen to the flame and cools the fire, creating competing effects. In microgravity, this flow is absent. Therefore, the fire is sustained only by the oxygen that it consumes as it migrates along the fuel's surface. The results of the SSCE have a practical application in the evaluation of spacecraft fire hazards, as well as providing a better understanding of flame propagation in microgravity and on Earth.

The SSCE occupies four standard lockers in the orbiter middeck. The experiment consists of two parts -- the chamber module and the camera module. The chamber module consists of a sealed combustion chamber which houses the sample and is filled with a combination of oxygen and nitrogen. The chamber has two perpendicular viewports -- one on the side and one on the top.

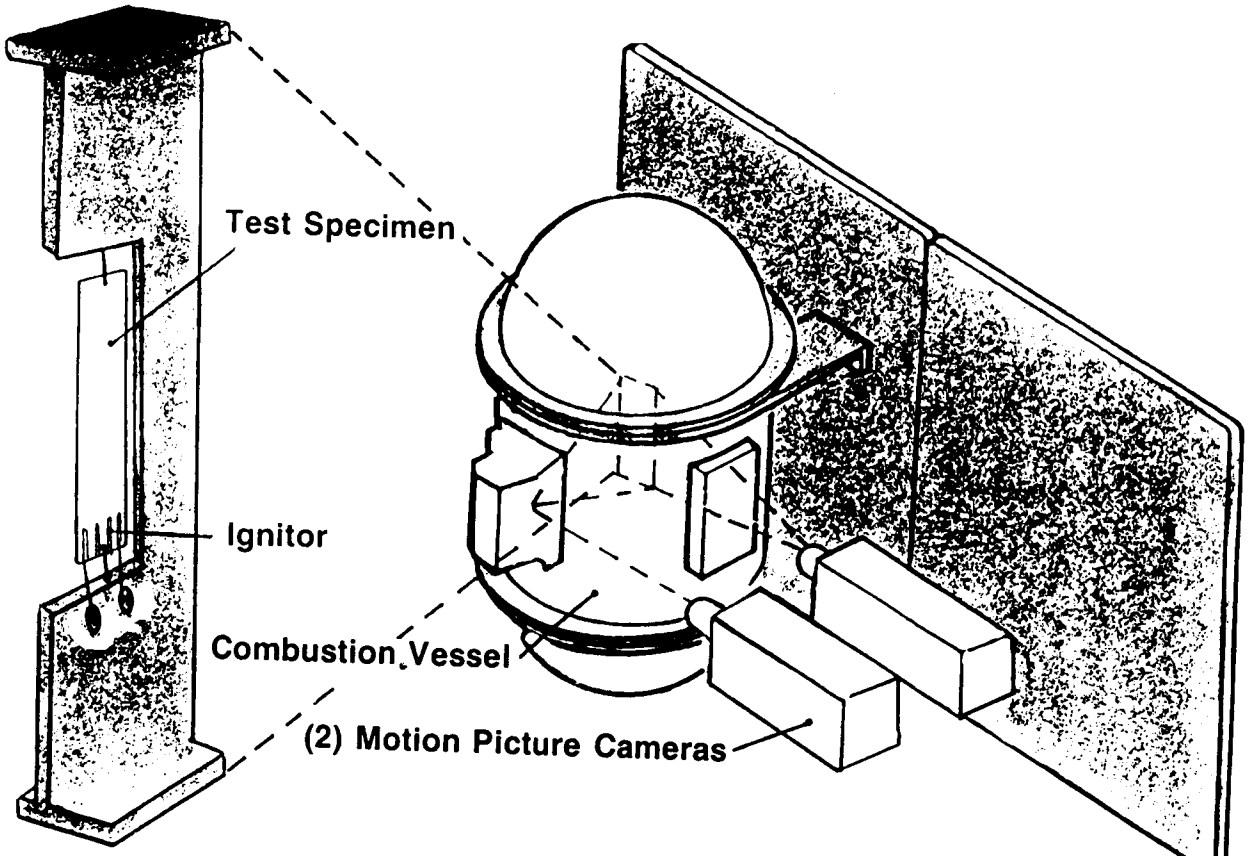
Two 16-mm color movie cameras mounted on the camera module record the combustion process through the viewports. In addition, thermocouples measure temperature data while a pressure transducer measures changes in chamber pressure. These data are stored in the experiment computer for post-flight analysis.

Ashless filter paper was tested on the first five flights with different mixtures of oxygen and nitrogen and with varying pressures. The final three tests will use polymethylmethacrylate (PMMA), commonly known as Plexiglas™. Typically, one configuration will be tested per mission. For this mission, the chamber will contain a 35:65 ratio by volume of oxygen to nitrogen at a total pressure of 1.0 atmosphere.

A crew member provides power to the experiment and by activating a switch, the crew member ignites the fuel and data collection begins. After approximately 75 seconds, the sample self-extinguishes and data collection ceases. The entire process takes approximately 25 minutes.

This is the sixth in a series of eight experiments studying flame propagation in space. The experiment was flown aboard the STS-41, STS-40, STS-43, STS-50 and STS-47 Shuttle missions in October 1990, June 1991, August 1991, June 1992 and September 1992, respectively.

SOLID SURFACE COMBUSTION EXPERIMENT (SSCE)



SSCE was conceived by Professor Robert A. Altenkirch, Dean of Engineering at Mississippi State University, and was built by the NASA Lewis Research Center, Cleveland. The project is sponsored by the NASA Microgravity Science and Applications Division of the Office of Space Science and Applications.

APPLICATION SPECIFIC PREPROGRAMMED EXPERIMENT CULTURE SYSTEM PHYSICS OF TOYS (ASPEC)

Physics of Toys

The STS-54 mission will carry a collection of children's toys for an educational post-flight videotape on the Physics of Toys. A similar opportunity took place on STS-51D in April 1985, and the subsequent videotape of demonstrations conducted by the crew has become one of the most popular educational resources NASA has offered to schools.

Toys have long been used to help teach basic and advanced scientific principles and concepts of force, motion and energy. Many toys depend on these principles and concepts to function. Although teachers are able to anticipate what toys may do in space, free from the gravity vector, unexpected actions may be observed. The possibility of discovery turns Physics of Toys from just a collection of valuable science demonstrations into legitimate science experiments.

The tape to be created on STS-54 will feature new toys, toys that have been flown before and toys that children can make themselves. The tape will be available to schools in the Fall of 1993. The tape will use toys to teach some basic principles of science and math to students using an investigative approach. Children will be encouraged to investigate the same toys in the normal 1-gravity environment of Earth and then speculate on what those same toys will do in the microgravity of space flight.

In addition to the videotape, selected students in grades 3-5 from the crewmembers' hometowns will actively participate as investigators and will talk with the orbiting crew. Through telephone and television links, these students, while in their classrooms or other school facilities, will ask the crew questions about the Physics of Toys experiments. In preparation for this opportunity, NASA traveled to each of the schools involved and conducted pre-experiments with the toys.

The Physics of Toys experiment is scheduled around noon EST on flight day 3. The experiment will begin with a brief videotape showing highlights of the mission and a few of the coming events. There will be a brief introduction to the experiment and then the first crewmember will take questions. Only one school will be able to talk to a crewmember at a time. Each school will have approximately 8 minutes. The order of the crewmembers and schools is as follows.

o Sacred Heart School, Bronx, N.Y., will experiment with car and track and klacker balls. (Mario Runco)

o Thomas A. Edison Elementary School, Willoughby, Ohio, will experiment with a basketball and magnetic marbles. (Greg Harbaugh)

o Shaver Elementary School, Portland, Ore., will experiment with swimming toys and a flipping mouse. (Susan Helms)

o Westwood Heights Schools, Flint, Mich., will experiment with gravitrons and a balloon helicopter. (Donald McMonagle)

Any time remaining in the experiment after all schools have asked their questions will be filled with selected demonstration of flying toys by crew Commander John Casper.

STS-54 CREW BIOGRAPHIES

John H. Casper, 48, Col., USAF, is Commander of Endeavour's third space mission. Selected to be an astronaut in 1984, Casper, from Gainesville, Ga., is making his second Shuttle flight.

Casper served as Pilot on Atlantis' STS-36 mission in February 1990, which carried Department of Defense payloads and a number of secondary payloads.

A graduate of Chamblee High School in Chamblee, Ga., in 1961, Casper received a bachelor of science degree in engineering science from the U.S. Air Force Academy in 1966 and a master of science degree in astronautics from Purdue University in 1967. He is a 1986 graduate of the Air Force Air War College.

Casper received his pilot wings at Reese Air Force Base, Texas, in 1968 and has logged more than 6,000 flying hours in 50 different aircraft. His first Shuttle mission lasted 106 hours.

Donald (Don) R. McMonagle, 38, Col., USAF, is Pilot of STS-54. Born in Flint, Mich., McMonagle was selected as a pilot astronaut in 1987 and made his first flight as a mission specialist aboard Discovery on STS-39 in April 1991, an unclassified Department of Defense mission.

McMonagle graduated from Hamady High School in Flint in 1970. He holds a bachelor of science degree in astronautical engineering from the U.S. Air Force Academy and a master of science in mechanical engineering from California State University, Fresno.

He graduated from pilot training at Columbus Air Force Base, Miss., in 1975 and has more than 4,200 hours of flying experience in a variety of aircraft, primarily the T-38, F-4, F-15 and F-16. He logged more than 199 hours in space on his first Shuttle mission.

Gregory (Greg) J. Harbaugh, 35, will serve as Mission Specialist 1. Before being selected as an astronaut in 1978, Harbaugh held engineering and technical management positions in various areas of Space Shuttle flight operations -- particularly data processing systems -- and supported real-time Shuttle operations from the JSC Mission Control Center for most of the flights from STS-1 to STS-51L.

Harbaugh, who considers Willoughby, Ohio, as his hometown, graduated from Willoughby South High School in 1974, received a bachelor of science degree in aeronautical and astronautical engineering from Purdue University in 1978 and a master of science degree in physical science from the University of Houston-Clear Lake in 1986.

Harbaugh flew as a mission specialist on STS-39 and was responsible for operation of the remote manipulator system robot arm and the Infrared Background Signature Survey spacecraft. With the completion of the mission, he had logged 199 hours in space.

Mario Runco Jr., 39, Lt. Cdr., USN, will serve as Mission Specialist 2. From Yonkers, N.Y., Runco graduated from Cardinal Hayes High School in the Bronx, N.Y., in 1970.

He received a bachelor of science degree in meteorology and physical oceanography from City College of New York in 1974 and a master of science degree in meteorology from Rutgers University, New Brunswick, N.J., in 1976.

After graduating from Rutgers, Runco worked for a year as a research hydrologist conducting ground water surveys for the U.S. Geological Survey on Long Island, N.Y. He worked as a New Jersey State Trooper until entering the U.S. Navy in 1978 and being commissioned that same year.

He served in various Navy posts, being designated a Naval Surface Warfare Officer and conducting hydrographic and oceanography surveys of the Java Sea and Indian Ocean before joining NASA.

Runco served as a mission specialist aboard Atlantis on STS-44 in November 1991, which deployed the Defense Support Program satellite and conducted two Military Man in Space experiments, three radiation monitoring experiments and numerous medical tests. Runco logged more than 166 hours on that flight.

Susan J. Helms, 33, Capt., USAF, will serve as Mission Specialist 3 on STS-54. From Portland, Ore., she was selected as an astronaut in 1990.

Helms graduated from Parkrose Senior High School in Portland in 1976, received a bachelor of science degree in aeronautical engineering from the U.S. Air Force Academy in 1980 and a master of science degree in aeronautics and astronautics from Stanford University in 1985.

Helms was an F-16 weapons separation engineer at Eglin Air Force Base, Fla., and served as an assistant professor of aeronautics at the academy. In 1987, she attended Air Force Test Pilot School at Edwards Air Force Base, Calif. and worked as a flight test engineer and project officer on the CF-18 aircraft at CFB Cold Lake, Alberta, Canada. As a flight test engineer, she has flown in 30 different types of U.S. and Canadian military aircraft. This will be her first Space Shuttle flight.

MISSION MANAGEMENT FOR STS-54

NASA HEADQUARTERS, WASHINGTON, D.C.

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Brian O'Connor - Deputy Associate Administrator
Tom Utsman - Director, Space Shuttle
Leonard Nicholson - Manager, Space Shuttle
Brewster Shaw - Deputy Manager, Space Shuttle

Office of Space Science and Applications

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Al Diaz - Deputy Associate Administrator
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Robert Benson - Director, Flight Systems Division
David Jarrett - DXS Program Manager
Dr. Louis Kaluzienski - DXS Program Scientist

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Jerry Fitts - Deputy Associate Administrator
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Daniel Brandel - Manager, TDRSS Continuation
Raymond Newman - Manager, Ground Segment
Wilson Lundy - Manager, White Sands Space Network Complex

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Charles Mertz - (Acting) Deputy Associate Administrator
Richard Perry - Director, Programs Assurance

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Jay F. Honeycutt - Director, Shuttle Management and Operations
Robert B. Sieck - Launch Director
John J. "Tip" Talone - Endeavour Flow Director
J. Robert Lang - Director, Vehicle Engineering
Al J. Parrish - Director of Safety Reliability and Quality Assurance
John T. Conway - Director, Payload Management and Operations
P. Thomas Breakfield - Director, Shuttle Payload Operations
Joanne H. Morgan - Director, Payload Project Management
Roelof Schuiling - STS-54 Payload Processing Manager

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Harry G. Craft - Manager, Payload Projects Office
Alexander A. McCool - Manager, Shuttle Projects Office
Dr. George McDonough - Director, Science and Engineering
James H. Ehl - Director, Safety and Mission Assurance
Otto Goetz - Manager, Space Shuttle Main Engine Project
Victor Keith Henson - Manager, Redesigned Solid Rocket Motor Project
Cary H. Rutland - Manager, Solid Rocket Booster Project
Parker Counts - Manager, External Tank Project

JOHNSON SPACE CENTER, HOUSTON

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Paul J. Weitz - Deputy Director
Daniel Germany - Manager, Orbiter and GFE Projects
David Leestma - Director, Flight Crew Operations
Eugene F. Kranz - Director, Mission Operations
Henry O. Pohl - Director, Engineering
Charles S. Harlan - Director, Safety, Reliability and Quality Assurance

STENNIS SPACE CENTER, BAY ST LOUIS, MISS.

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Gerald Smith - Deputy Director
J. Harry Guin - Director, Propulsion Test Operations

AMES-DRYDEN FLIGHT RESEARCH FACILITY, EDWARDS, CALIF.

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James R. Phelps - Chief, Shuttle Support Office

AMES RESEARCH CENTER, MOUNTAIN VIEW, CALIF.

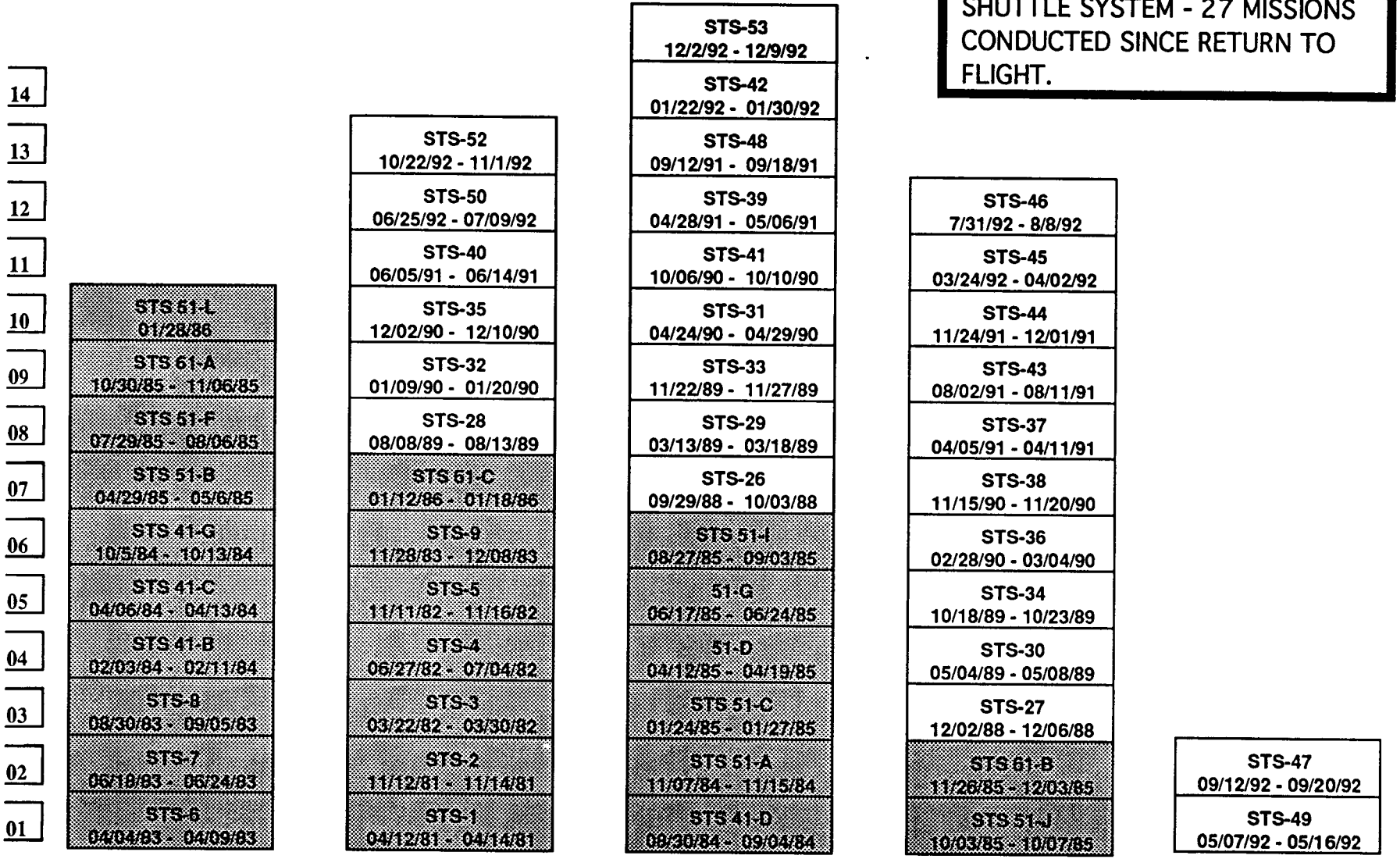
Dr. Dale L. Compton - Director
Victor L. Peterson - Deputy Director
Dr. Joseph C. Sharp - Director, Space Research

GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.

Dr. John Klineberg - Center Director
Thomas E. Huber - Director, Engineering Directorate
Theodore C. Goldsmith - Project Manager, Shuttle Small Payloads
Steven C. Dunker - DXS Project Manager
Vernon J. Weyers - Director, Flight Projects
Dale L. Fahnestock - Director, Mission Operations and Data Systems
Daniel A. Spintman - Chief, Networks Division
Vaughn E. Turner - Chief, Communications Division
Charles Vanek - Project Manager, TDRS
Thomas E. Williams - Deputy Project Manager, TDRS
Anthony B. Comberiate - TDRS Manager
Gary A. Morse - Network Director

SHUTTLE FLIGHTS AS OF DECEMBER 1992

52 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM - 27 MISSIONS CONDUCTED SINCE RETURN TO FLIGHT.



NASA News

National Aeronautics and
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Washington, D.C. 20546
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Jim Elliott
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For Release
January 4, 1993
11:30 A.M. EST

RELEASE: 93-1

MYSTERIOUS CONCENTRATION OF DARK MATTER DISCOVERED

Astronomers have discovered a huge concentration of mysterious "dark matter" using the international ROSAT X-ray observatory.

The discovery appears to confirm previous suggestions of where most of the dark matter in the universe may be concentrated, namely in and around small groups of galaxies, according to astronomers.

"The new findings add much weight to the theory that most of the mass of the universe consists of dark matter, the precise nature of which remains unknown to scientists," said John S. Mulchaey of the Space Telescope Science Institute, Baltimore, Md., and the University of Maryland, College Park.

Dark matter is believed to exist although it has never been seen because it emits no radiation. Its existence has been inferred because fluctuations observed in the Big Bang -- the explosion presumed to have created the universe -- did not have sufficient gravitational pull to cause ordinary matter to coalesce immediately. It is presumed, therefore, that unknown, or dark, matter that would be attracted to the weak gravity of the fluctuation got the process started.

Scientists also presume the existence of the invisible material because the speeds with which certain galaxies are moving, their rotational patterns and their shapes cannot be accounted for by the possible gravitational pull of observable matter close enough to influence them.

Dark matter may, in fact, constitute up to 95 percent of the mass of the universe. Confirming its existence and volume would mean that there might be enough mass in space to "close the universe." This means that eventually the expansion of the universe, which is being slowed by the pull of gravity, would come to a halt or nearly so.

- more -

The discovery announced today was made with x-ray pictures of three galaxies known as the "NGC 2300 group," located about 150 million light-years from Earth in the direction of the northern constellation Cepheus. (One light-year is the distance light travels in 1 year, approximately 5.8 trillion miles.)

The images were taken with the Position Sensitive Proportional Counter instruments on ROSAT during April 25-27, 1992, according to Dr. Richard F. Mushotzky, NASA Goddard Space Flight Center, Greenbelt, Md. They show that the small group of galaxies is immersed in a huge cloud of hot gas, about 1.3 million light-years in diameter, he explained.

500 Billion Times The Sun

Astronomers estimate that the cloud has a mass equal to 500 billion times that of the sun and is at a temperature of approximately 18 million degrees Fahrenheit (10 million degrees Kelvin).

"A cloud like this would have dissipated into space long ago, leaving nothing for us to detect, unless it was held together by the gravity of an immense mass," Mushotzky said. "The mass required to restrain the cloud is about 25 times greater than the mass of the three galaxies that are present."

This is the first time that a multimillion degree gas has been found to pervade a small group of galaxies, the Goddard astronomer explained, although such gas has been detected in larger clusters of galaxies by earlier satellite telescopes such as NASA's High Energy Astronomy Observatory-2.

Results from the Hubble Space Telescope and other satellites already have shown that if the leading version of the Big Bang theory is correct, then 90 to 95 percent of the mass in the universe must be in the unknown "dark" form, astronomers explain. This means, they say, that there must be 10 to 20 times as much dark matter by mass as ordinary matter, which scientists call "baryonic matter."

However, in locations observed previous to this work, the ratio of dark to ordinary matter has been, at most, a factor of two to four. Much of that work concentrated on studies of the most prominent groups of galaxies in space, the "rich clusters," according to astronomers. "Rich clusters" are huge aggregates of hundreds to thousands of galaxies.

"Although they stand out the best and therefore, have been the subject of most of the research on dark matter, they are not representative of the universe, because most galaxies are in small groups like the NGC 2300 group," Mulchaey explained.

"The universe is like the pre-industrial United States, in which the most conspicuous population concentrations were in a few big cities, but in which most people actually lived in small towns and rural America," he said.

If small groups of galaxies all have comparable ratios of dark to ordinary matter, meaning a factor of 12 to 25 as found in the NGC 2300 group rather than a factor of four or less as found in rich clusters of galaxies, Mulchaey explained, then the mystery of where most of the dark matter in the universe is located has been solved.

Closed Universe

That would mean that there might be enough mass in space to "close the universe," indicating that eventually the expansion of the universe, which is being slowed by the pull of gravity, would come to a halt or nearly so, he continued.

Although some scientists have suggested that the dark matter might be preferentially concentrated in small groups of galaxies, direct evidence was lacking until ROSAT observations were made, according to the astronomers. Further work is needed to confirm a discovery of this apparent magnitude, they admit.

This work represents the first case in which the amount of dark matter in a small group of galaxies has been determined accurately, the science team reported.

"For confirmation, we need repeated x-ray observations from space of the NGC 2300 group and other representative small groups of galaxies," Mushotzky explained. "Meanwhile, if we are right, the theorists need to start thinking about why there is much dark matter where there is little ordinary matter (i.e. in small groups of galaxies), and there is much less dark matter where there is a lot of ordinary matter (in rich clusters of galaxies)," he said.

The discovery is to be announced today at a meeting of the American Astronomical Society in Phoenix, Ariz., by Mulchaey; David S. Davis, NASA Goddard Space Flight Center and the University of Maryland; Dr. Richard F. Mushotzky; and Dr. David Burstein, Arizona State University, Tempe.

Mulchaey and Davis are University of Maryland graduate students who work with Dr. Mushotzky's research group at the Goddard Space Flight Center. Mulchaey currently is employed at the Space Telescope Science Institute. Dr. Burstein is a Professor of Astronomy at Arizona State.

ROSAT, an acronym for Roentgen Satellite, is a joint project of Germany, the United States and the United Kingdom. It was launched on a Delta II rocket from the Cape Canaveral Air Force Station, Fla., on June 1, 1990.

- end -

EDITORS NOTE: A video and photograph to illustrate this story is available by calling NASA's Broadcast and Imaging Branch on 202/358-1741.

Color	B&W
92-HC-730	92-H-791

NASA News

National Aeronautics and
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For Release
January 5, 1993

RELEASE: 93-002

NASA INVENTION YIELDS BETTER, FASTER STRESS MEASUREMENTS

A NASA engineer has developed an idea that could revolutionize the way engineers measure strains and stresses on products as varied as cars, planes and nuclear reactors.

Karl Anderson at NASA's Ames-Dryden Flight Research Facility, Edwards, Calif., has invented a method to prevent errors caused by temperature changes in the wires that connect instruments, called strain gages, to recording devices. Anderson's method uses a circuit called a "constant current loop" that produces more accurate data while using smaller and sometimes fewer wires.

"I had been aware of the problem since coming to NASA in 1964," said Anderson. "About a year ago, I came up with a different point of view and was able to find a practical solution."

Researchers use strain gages to do structural tests on new products. The common testing method uses a wiring system called the "Wheatstone bridge" that has been employed for almost 150 years. However, thermal changes in the wires can result in errors when specimen temperatures vary greatly.

Anderson's new constant current loop circuit suppresses unwanted effects from the lead wires and records only the correct strain and stress data. It should produce great cost and time savings because engineers now can get valid measurements easily in situations where earlier tests had to be repeated and averaged to get accurate readings.

"The constant current loop will tremendously benefit the measurement world that relies on electrical resistance to show what is going on," said Anderson.

-more-

NASA has applied for patents on the innovation. Anderson will present the new constant current method for strain gage signal conditioning and test results at a Western Regional Strain Gage Committee meeting in Pasadena, Calif., in February and at the International Instrumentation Symposium in Albuquerque, N.M., in May.

NASA Technical Memorandum 104260, which details Anderson's research results, is available from the National Technical Information Service, 5285 Port Royal Road, Springfield, Va. 22161.

-end-

NASA News

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For Release

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January 6, 1993

Jim Elliott
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(Phone: 301/286-6256)

N93-002

NEW HUBBLE SPACE TELESCOPE PHOTOGRAPHS RELEASED TODAY

Two HST photographs are available to media representatives through NASA's Broadcast and Imaging Branch, 202/358-1741. Today, both images are being presented at the 181st Meeting of the American Astronomical Society in Phoenix, Ariz.

New Details in a Supernova's Blast Wave

The HST image shows with unprecedented clarity the structure behind the shock waves in the Cygnus Loop supernova remnant. This is allowing astronomers, for the first time, to directly compare the actual structure of the shock with theortical model calculations.

The supernova blast wave is slamming into tenuous clouds of interstellar gas. This collision heats and compresses the gas, causing it to glow. The shock acts as a searchlight by revealing the structure of the interstellar medium.

The Cygnus Loop marks the edge of a bubble-like, expanding blast wave from a colossal stellar explosion which occurred about 15,000 years ago. (Color: 92-HC-731 -- B&W: 92-H-792)

Hubble Finds a Young Planetary Nebula

The image shows an expanding cloud of gas that was ejected from the aging star in the center. Before the Hubble observations, little was known about the nebula's structure because it is too small for any detail to be seen using ground-based telescopes. The planetary nebula, known as Hen 1357, is about 18,000 light-years away and located in the southern constellation Ara the Altar. (Color: 92-HC-732 -- B&W: 92-H-793)

- end -

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For Release

Barbara Selby
Headquarters, Washington, D.C.
(Phone: 202/358-1600)

January 6, 1993

RELEASE: 93-003

NASA SELECTS PHASE II SMALL BUSINESS INNOVATION RESEARCH PROJECTS

NASA announced today the selection of 38 research proposals for immediate negotiation of phase II contracts in NASA's Small Business Innovation Research Program (SBIR). The selected projects, having a total value of approximately $19 million, will be conducted by 36 small businesses located in 18 states.

Approximately 100 additional phase II selections will be made in January and February 1993, bringing the total number of selections in this procurement to approximately 140 and the total contract value to approximately $70 million.

"The recent re-authorization of the SBIR program through Fiscal Year 2000 is a strong vote of confidence. The program is meeting its objectives, and its accomplishments are benefitting both NASA and the economy," stated Harry Johnson, Director of NASA's SBIR program.

SBIR phase II supports development of the most promising research innovations that demonstrated technical feasibility and high potential value at the end of phase I. All phase II projects are being chosen competitively from more than 275 proposals submitted by small businesses completing their phase I projects in 1992. Selection criteria include technical merit and innovation, phase I results, company capabilities, value to NASA and commercial potential. Each project may run 2 years and be funded up to $500,000.

SBIR objectives are to stimulate technological innovation in the United States by using small business, including minority and disadvantaged firms, to help federal agencies meet their research and development needs and to encourage commercial applications of federally funded research innovations.

- end -

EDITOR'S NOTE: A listing of companies selected for this program is available at NASA Headquarters newsroom by calling 202/358-1600 and at all NASA centers.

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For Release

Ed Campion
Headquarters, Washington, D.C.
(Phone: 202/453-8536)

January 6, 1993

RELEASE: 93-004

FIRST 1993 SHUTTLE MISSION DEMONSTATES UNIQUE CAPABILITIES

The versatility of NASA's Space Shuttle system will be demonstrated next week during the first mission of 1993 when Shuttle Endeavour and her crew conduct a diverse group of experiments and tasks in Earth orbit.

During the mission, a communications satellite will be deployed, x-ray astronomy observations will be taken, experiments covering a wide range of scientific disiplines will be conducted and a spacewalk to evaluate training techniques will be performed.

Endeavour and her crew are scheduled to be launched on Wednesday, Jan. 13 with a launch window opening at 8:52 a.m. EST. The mission duration is approximately 6 days with landing scheduled for Tuesday, Jan. 19 at Kennedy Space Center, Fla.

Crew members for the STS-54 mission are Commander John Casper, Pilot Don McMonagle and three mission specialists -- Mario Runco, Jr., Greg Harbaugh and Susan Helms. The STS-54 mission will be the third flight of Space Shuttle Endeavour and the 53rd flight of the system overall.

Tracking and Data Relay Satellite System

The Tracking and Data Relay Satellite System (TDRSS) is a space-based network that provides communications, tracking, telemetry, data acquisition and command services essential to the Space Shuttle and low-Earth orbital spacecraft missions. All Shuttle missions and nearly all NASA spacecraft in Earth orbit require TDRSS's capabilities for mission success.

Tracking and Data Relay Satellite (TDRS-6) being deployed on the STS-54 mission is the sixth in a series of communications spacecraft planned for the TDRS system.

- more -

The successful launch and checkout of TDRS-6 will give NASA the essential requirement of having two fully operational satellites and a fully operational ready reserve capability. This will assure that NASA communications, telemetry and data acquisition capabilities required by space missions will not be jeopardized.

Diffuse X-ray Spectrometer

The Diffuse X-ray Spectrometer (DXS) addresses a fundamental question of present-day astrophysics: What is the origin and nature of the interstellar medium -- the matter that fills the space between stars?

A large percentage of x-rays from space do not originate from specific objects like stars or galaxies, but from some source that appears to be distributed over the entire sky. Astronomers have found that these emissions fall into two types: high-energy or "hard" x-rays that may be the unresolved emissions from a collection of distant galaxies and low-energy or "soft" x-rays that are not yet well understood. DXS will study the latter.

Because low energy x-rays cannot travel more than a few hundred light years in interstellar space before they are absorbed, most of the diffuse soft x-ray background observed must have originated in the Milky Way galaxy from the vicinity of Earth's solar system.

The DXS measures the arrival direction and wavelength of incident low energy x-rays in the wavelength range of 42 to 84 Angstroms (an Angstrom is one ten-thousandth of a millimeter). From this information, the DXS scientists will be able to determine the spectrum (brightness at each wavelength) of the diffuse soft x-ray background from each of several regions of the sky.

By analyzing these spectral features, scientists can identify the temperature, the ionization state and the elements which constitute this plasma. From these data they can tell whether the plasma is young and heated in the last 100,000 years or old and heated millions of years ago.

Previous experiments were not capable of measuring the spectrum of the diffuse soft X-ray background.

EVA Test Objectives

On the fifth day of the STS-54 flight, Mission Specialists Greg Harbaugh and Mario Runco, Jr., will perform the first in a series of test spacewalks to be conducted on Shuttle missions during the years leading up to the construction of Space Station Freedom, scheduled to begin in 1996.

The spacewalk tests are designed to refine training methods for future spacewalks; expand the experience of ground controllers, instructors and astronauts; and aid in better understanding the differences between true weightlessness and the underwater facility used to train crew members.

During the STS-54 spacewalk, Runco and Harbaugh will evaluate how well they respectively adapt to spacewalking; test their abilities to move about the cargo bay with and without carrying items; test the ability to climb into a foot restraint without handholds; and test their ability to align a large object in weightlessness.

CHROMEX-4

Developmental and Physiological Processes Influencing Seed Production in Microgravity (CHROMEX-4) is designed to gain an understanding of the reproductive abnormalities which apparently occur in plants exposed to microgravity and to determine whether changes in developmental processes may be due to spaceflight conditions, especially microgravity. This experiment also will help scientists understand how gravity influences fertilization and development on Earth.

To date, only a few studies have been conducted on developing seeds in space. They all showed very poor seed production. NASA would like to use plants as a source of food and atmospheric cleansing for astronauts staying in space for extended periods of time. Seed production is vital if crops like wheat and rice are to be utilized for food.

Commercial Generic Bioprocessing Apparatus

The purpose of the Commercial Generic Bioprocessing Apparatus (CGBA) is to allow a wide variety of sophisticated biomaterials, life sciences and biotechnology investigations to be performed in one apparatus in microgravity.

During the STS-54 mission, the CGBA will support 28 separate commercial investigations, loosely classified in three application areas: biomedical testing and drug development, controlled ecological life support system and agricultural development and manufacture of biological-based materials.

Results from the 28 investigations will be carefully considered in determining subsequent steps toward commercialization. STS-54 marks the second of six CGBA flights. Future flights will continue to focus on selecting and developing investigations that show the greatest commercial potential.

Physiological and Anatomical Rodent Experiment

The second Physiological and Anatomical Rodent Experiment (PARE.02) is a secondary payload flight experiment located in a locker on the Space Shuttle's mid-deck. The goal of PARE.02 is to determine the extent to which short-term exposure to microgravity alters the size, strength and stamina of skeletal muscles normally used to support the body against the force of gravity.

The PARE.02 experiment is important for two reasons. When individuals are exposed to the microgravity of spaceflight, there appears to be a significant loss in muscle mass. This appears to be because the muscle must no longer exert a sufficient level of force, which produces a signal to the body to conserve mass.

However, the loss of muscle mass hinders one's capability to function when returning to Earth. All movement patterns are difficult, and the individual may be prone to accidents because of this instability. Scientists need to find out the extent to which the muscle atrophies, what impact the atrophy process has on muscle performance and how to prevent the atrophy from occurring.

Second, the problem of muscle atrophy is similar in part to what is seen on Earth during the normal span of aging. As one gets older, he or she becomes less physically active, and the degree of muscle disuse is exaggerated. This leads to the same problems as occur during exposure to microgravity. Thus, if the problem of atrophy in space can be solved, scientists should have good insight for maintaining the muscle system in a more viable condition as people age.

Solid Surface Combustion Experiment

The purpose of the Solid Surface Combustion Experiment (SSCE) is to study the physical and chemical mechanisms of flame propagation over solid fuels in the absence of gravity-driven buoyant or externally-imposed airflows. The controlling mechanisms of flame propagation in microgravity are different than in normal gravity.

On Earth, gravity causes the air heated by the flame to rise. This air flow, called buoyant convection, feeds oxygen to the flame and cools the fire, creating competing effects. In microgravity, this flow is absent. Therefore, the fire is sustained only by the oxygen that it consumes as it migrates along the fuel's surface. The results of the SSCE have a practical application in the evaluation of spacecraft fire hazards, as well as providing a better understanding of flame propagation in microgravity and on Earth.

- end -

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Ed Campion
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Results from the 28 investigations will be carefully considered in determining subsequent steps toward commercialization. STS-54 marks the second of six CGBA flights. Future flights will continue to focus on selecting and developing investigations that show the greatest commercial potential.

Physiological and Anatomical Rodent Experiment

The second Physiological and Anatomical Rodent Experiment (PARE.02) is a secondary payload flight experiment located in a locker on the Space Shuttle's mid-deck. The goal of PARE.02 is to determine the extent to which short-term exposure to microgravity alters the size, strength and stamina of skeletal muscles normally used to support the body against the force of gravity.

The PARE.02 experiment is important for two reasons. When individuals are exposed to the microgravity of spaceflight, there appears to be a significant loss in muscle mass. This appears to be because the muscle must no longer exert a sufficient level of force, which produces a signal to the body to conserve mass.

However, the loss of muscle mass hinders one's capability to function when returning to Earth. All movement patterns are difficult, and the individual may be prone to accidents because of this instability. Scientists need to find out the extent to which the muscle atrophies, what impact the atrophy process has on muscle performance and how to prevent the atrophy from occurring.

Second, the problem of muscle atrophy is similar in part to what is seen on Earth during the normal span of aging. As one gets older, he or she becomes less physically active, and the degree of muscle disuse is exaggerated. This leads to the same problems as occur during exposure to microgravity. Thus, if the problem of atrophy in space can be solved, scientists should have good insight for maintaining the muscle system in a more viable condition as people age.

Solid Surface Combustion Experiment

The purpose of the Solid Surface Combustion Experiment (SSCE) is to study the physical and chemical mechanisms of flame propagation over solid fuels in the absence of gravity-driven buoyant or externally-imposed airflows. The controlling mechanisms of flame propagation in microgravity are different than in normal gravity.

On Earth, gravity causes the air heated by the flame to rise. This air flow, called buoyant convection, feeds oxygen to the flame and cools the fire, creating competing effects. In microgravity, this flow is absent. Therefore, the fire is sustained only by the oxygen that it consumes as it migrates along the fuel's surface. The results of the SSCE have a practical application in the evaluation of spacecraft fire hazards, as well as providing a better understanding of flame propagation in microgravity and on Earth.

- end -

NASA News

National Aeronautics and
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For Release:

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Office of Public Affairs
(301) 286-7277
Release No. 92-256

January 7, 1993
10:30 A.M. EST

NOTE TO EDITORS: NASA RELEASES NEW COSMIC BACKGROUND EXPLORER PHOTOS AT AMERICAN ASTRONOMIC SOCIETY MEETING, JANUARY 7

Four new images formed from data gathered by NASA's Cosmic Background Explorer will be released January 7 at the American Astronomical Society meeting in Phoenix, Arizona.

The images, created from Diffuse Infrared Background Experiment (DIRBE) data, show the Universe in the full range of infrared wavelengths from 1 to 240 micrometers. Each false-color image is a composite of infrared images at three separate, wavelengths represented from shortest to longest by blue, green and red.

The images show infrared sources such as dust within our Solar System, stars in the Milky Way Galaxy, and dust and stars in other galaxies. The appearance of each image depends on the temperature and spatial distribution of the sources. To make the contributions from the Solar System as uniform as possible, the images are made from observations when the Sun angle was 90 degrees from the viewing direction.

The DIRBE is the first space instrument designed to make a comprehensive search for an ancient fossil known as cosmic infrared background (CIB) radiation -- the remnant from the formation of the earliest objects in the Universe created 10 to 15 billion years ago. Extensive modeling, now underway, is required to isolate the CIB from the foregrounds from the Solar System and Galaxy .

COBE, launched November 9, 1989, is managed by NASA's Goddard Space Flight Center, Greenbelt, Md., for NASA's Office of Space

NASA News

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Washington, D.C. 20546
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ISY

For Release

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January 7, 1993
10:30 A.M. EST

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RELEASE: 93-5

BIG BANG THEORY PASSES TOUGHEST TEST

The Big Bang Theory passed its toughest test yet with the latest results reported from NASA's Cosmic Background Explorer (COBE) team at the American Astronomical Society meeting in Phoenix, Ariz., today.

Precise measurements made by COBE's FIRAS of the afterglow from the Big Bang -- the primeval explosion that began the universe approximately 15 billion years ago -- show that 99.97 percent of the early radiant energy of the universe was released within the first year after the Big Bang itself.

"Radiant energy" is energy emitted in any form of light, from x-rays and gamma rays to visible and infrared light or even radio waves. COBE's Far Infrared Absolute Spectrophotometer (FIRAS) was designed to receive the microwave and infrared energy from the Big Bang.

"The Big Bang theory comes out a winner," said COBE Project Scientist and FIRAS Principal Investigator Dr. John C. Mather of NASA's Goddard Space Flight Center, Greenbelt, Md. "This is the ultimate in tracing one's cosmic roots," Mather said.

All theories that attempt to explain the origin of large scale structure seen in the universe today now must conform to the constraints imposed by these latest measurements.

This includes theories that postulate large amounts of energy released by such things as black holes, exploding supermassive stars or the decay of unstable elementary particles. In other words, there were not a lot of "little bangs," as suggested by some theories.

- more -

The Big Bang Theory predicts that the spectrum of relic radiation should be that of a perfect "black body" unless there were major energy releases more than a year after the explosion. (A black body is a hypothetical cosmic body that absorbs all radiation falling on it, but reflects none what-so-ever. A black body emits at the same temperature at every wavelength.) These latest FIRAS results reveal that later energy releases did not occur.

The COBE scientists now can say that the temperature of the afterglow radiation is 2.726 degrees above absolute zero (273 degrees below zero on the Celsius scale) with an uncertainty of only 0.01 degrees.

Today's announcement is the result of analyzing data from the FIRAS during its 10 months of observations. Hundreds of millions of measurements were combined to obtain these unprecedentedly precise results.

"Making certain that all of the measurements were combined correctly required exquisitely careful work and lengthy analysis by a large team of COBE scientists," Mather reported.

"We are seeing the cold glow still remaining from the initially very hot Big Bang. These results now limit the size of any 'after shocks' following the Big Bang. The closer we examine the Big Bang the simpler the picture gets," said Mather.

"It took us 18 years of careful effort to reach this point, but now we can say that the Big Bang Theory has been tested against observations to a fine degree of precision," explained Mather.

"Experimental evidence of the Big Bang was first found by Edwin Hubble in the 1920's. He found that distant galaxies in ever direction are going away from us with speeds proportional to their distance. Therefore, gallaxies that are farther away are going faster. This is exactly the pattern that would occur if the entire universe originated in a single explosion, now called the Big Bang.

Papers on these results and their implications soon will be submitted to the Astrophysical Journal for publication.

COBE, launched Nov. 18, 1989, is managed by NASA's Goddard Space Flight Center, for NASA's Office of Space Science and Applications, Astrophysics Division, Washington, D.C.

- end -

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January 7, 1993
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RELEASE: 93-006

HUBBLE DISCOVERS A DOUBLE NUCLEUS IN CORE OF ACTIVE GALAXY

Astronomers, using the Hubble Space Telescope, now believe that a galaxy they have observed for a decade actually is composed of two merged galaxies and that the collision has provided new fuel for a massive black hole which is spewing out a jet of gas and other matter 240,000 light-years long.

The galaxy is Markarian 315 located about 500 million light-years from Earth. The collision and refueling theory emerged after the Hubble Telescope revealed that the galaxy has a double nucleus or two core-like regions.

The brighter core-like region is believed to harbor the massive black hole which accounts for the tremendous amounts of energy produced by the galaxy. The fainter nucleus is considered to be the surviving core of a galaxy that recently merged into Markarian 315.

"The galaxy's active core presumably harbors a black hole which has been re-fueled by the galactic collision," said Dr. Jack MacKenty, Assistant Scientist at the Space Telescope Science Institute in Baltimore.

"The Hubble images provide support for the theory that the jet-like feature may be a 'tail' of gas stretched out by tidal forces between the two galaxies as they interacted," explained Dr. MacKenty, Assistant Scientist at the Space Telescope Science Institute.

"The jet feature is most likely a remnant of a merger between Markarian 315 and a smaller galaxy," said MacKenty. This observation best explains the extraordinary 240,000-light-year long jet-like feature of Markarian 315.

- more -

An image of the core of Markarian 315, taken with the Hubble Space Telescope's Wide Field and Planetary Camera shows a second, fainter nucleus located approximately 6,000 light-years (or 2 arc seconds in angular separation) from the galaxy's bright central nucleus. One light-year equals approximately 5.8 trillion miles (9.3 trillion km).

Galaxy mergers may be one mechanism for driving gas deep into the heart of a galaxy, astronomers believe. This raw material fuels massive black holes, theorized to be the "central engines" in Seyfert galaxies and other active galaxies.

The Hubble Space Telescope's high spatial resolution allows astronomers to probe the cores of Seyfert galaxies in unprecedented detail. In exposures taken with ground-based telescopes, the companion nucleus is drowned out by the brighter Seyfert nucleus.

The report on this discovery is by Drs. John MacKenty and Andrew Wilson of the Space Telescope Science Institute, Baltimore; Richard Griffiths of The Johns Hopkins University, Baltimore; and Susan Simkin of Michigan State University, East Lansing. The report was delivered at the 181st Meeting of the American Astronomical Society meeting in Phoenix, Ariz.

The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency.

- end -

NOTE TO EDITORS: A photograph to illustrate this story is available by calling NASA's Broadcast and Imaging Branch on 202/358-1900.

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January 7, 1993

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RELEASE: 93-7

SPACE STATION FREEDOM PROPULSION FIRING TESTS UNDERWAY

Static firing tests of a propulsion development test article for Space Station Freedom began in late December at NASA's White Sands Test Facility (WSTF) in New Mexico.

The test series will validate the concept and preliminary design of the propulsion module to be used for space station attitude control, orientation, speed and altitude control and avoidance of space debris.

"Freedom is no longer a 'paper-station'," commented Richard Kohrs, Director of the Space Station Freedom Program in Washington, D.C.. "And the beginning of critical tests with the propulsion module system at White Sands represents the next and certainly not the last in a long string of reality checks for Freedom focussing on launch of the first element in the assembly sequence in about 3 years."

"We have seen Space Station Freedom progress from concept to design and now to validation of hardware," said Larry Morata, Vice President and General Manager of McDonnell Douglas Aerospace (MDA) Space Station Division. "We are on the way to constructing a facility that will promote science and exploration for years to come."

During Shuttle's second space station assembly flight, two propulsion modules will be positioned on Freedom. Two more will be added following man-tended capability and an additional pair will be added prior to permanently manned capability.

- more -

Early propulsion modules will have 13 thrusters located at both ends and on top of each module. On later modules, the number of thrusters will be scaled down to nine. The thrusters can be fired independently, allowing precise positioning of the station.

The article being tested in New Mexico has 10 small thrusters, each with an operational range of 9 to 25 pounds of thrust and three large thrusters with 20 to 55 pounds of thrust.

MDA Space Station Division, under contract to the NASA Johnson Space Center (JSC), Houston, is responsible for the development and testing. McDonnell Douglas previously carried out structural dynamics and vibration testing at JSC. The test series will continue at WSTF as needed to complete validation of the design.

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For Release

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January 8, 1993

RELEASE: 93-8

UNIVERSITIES FLY OZONE RESEARCH BALLOON FROM TEXAS TO FLA.

A NASA-sponsored university group will launch a high-altitude research balloon on Jan. 11, inaugurating a cooperative program to measure ozone distribution and wind parameters in the Earth's stratosphere.

Following launch from the South Shore Harbor Resort and Convention Center, League City, Texas, at 8 a.m. EST, the 76-foot diameter, helium-filled balloon will ascend to an altitude of 110,000 feet and fly across the Gulf of Mexico to Florida.

When the balloon reaches central Florida, a radio command will be sent to parachute the gondola and its instrument package back to Earth for recovery and reuse.

Throughout the day-long flight, cooperating teams of amateur radio operators in Texas, Louisiana, Mississippi, Alabama and Florida will receive position reports, ozone data and video images from the balloon's 50-pound gondola and will relay this information via high-frequency radio to a Utah State University balloon chase van.

The radio operators also will "home" on the payload's radio beacons to assist in recovering the gondola and balloon. In addition, the Federal Aviation Administration will track a radar transponder in the gondola during ascent and descent through controlled airspace.

The instrument package was designed and built by a volunteer team of space grant students and faculty from Utah State University's Space Dynamics Laboratory and from the Bridgeland Amateur Radio Club in the Cacha Valley of northern Utah. This flight is the eleventh for this team and the first of 24-hours' duration.

Extended-duration flights will be launched from Canada, the United States, Mexico and Central America to measure northern hemispheric ozone distribution and stratospheric circulation on a long-term basis.

- more -

The balloon is a revolutionary "superpressure" design manufactured by Winzen International of San Antonio and Sulphur Springs, Texas. It is fabricated of Nylon film thinner than a human hair and is designed to stay aloft continuously for a year or more.

The balloon launch is sponsored by NASA's National Space Grant College and Fellowship Program Office, Washington, D.C., and will take place during the third annual meeting of all 50 state consortia. The District of Columbia and Puerto Rico also are participating in the program.

- end -

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GOLDIN CALLS FOR IMPROVED TECHNOLOGY TRANSFER TO INDUSTRY

While NASA enjoys a good reputation for transferring technology to industry, major improvements must be made in the way technology is transferred, according to a report released today by NASA Administrator Daniel S. Goldin.

"NASA has the reputation of being the leader in technology transfer, but this position has eroded," Goldin said. "Our successes are modest compared to the amount of technology we generate."

"Our attitude that the transfer of our valuable technology will 'just happen' is no longer acceptable. It must be proactively sought and given the highest priority," Goldin said.

The report -- Special Initiatives Team on Technology Transfer -- was chartered last May, with Dr. Jeremiah Creedon, Director of Flight Systems at NASA Langley Research Center, Hampton, Va., as Chairman. Other participants from NASA include Dr. Kathy Abbot, Leonard Ault, Carol Ginty, George Mosakowski, Dr. Syed Shariq and Dr. William Spuck. Major Findings and Recommendations

The report contains a series of findings and recommendations for changing NASA's culture to facilitate technology transfer, including:

* No comprehensive written document exists that explains the formal processes for technology transfer;

* Processes for technology transfer within NASA are too slow to meet industry's needs;

* Technology is not sufficiently developed to reduce technical risk to industry due to the costs and mission objectives;

- more -

* Employees, managers and contractors all too often do not believe technology transfer is part of their job;

* There is little or no infrastructure support to help researchers transfer technology;

* Technology can and should be transferred at every stage, instead of waiting until a project is completed.

The report's 10 recommendations include a category of implementation and measurement of performance of technology transfer and eight recommendations for changing NASA's culture to facilitate technology transfer.

Technology Transfer Benefits Aeronautics

The report finds that where technology transfer was the primary mission activity -- such as aeronautics, the Small Business Innovative Research (SBIR) program and the Centers for Commercial Development of Space -- NASA's overall efforts are relatively good.

For instance, a strong relationship exists between NASA and the aeronautics industry. Many vital technologies developed by NASA have been transferred to the aeronautics industry, including such items as supercritical wings, winglets, glass cockpits and many others. Still, a recent Gallup poll concluded that the aeronautics industry felt there was room for improvement.

In addition, researchers often viewed technology transfer as writing a report on the research results after it was completed. This is representative of a common view that technology transfer occurs at the end of the development process.

Researchers often encounter roadblocks when attempting to transfer technology, including the time-consuming processes of filing patents and software distribution through official channels.

Finally, no systematic measurements or statistics are kept on the activities or effectiveness of primary targeted technology transfer. The team identifies six metrics which could be used to measure the effectiveness of the technology transfer process. These include the number of citations, acknowledged users and spin-off companies, the revenue from patent licenses, and the length of time from development to its transfer for use by a targeted customer.

The report found that the technology utilization offices are minimally staffed and cannot provide greater support for secondary and non-targeted technology transfer functions.

Advanced Concepts and Technology Office Established

NASA's Office of Advanced Concepts and Technology was created last November to better meet the needs of industry, academia and NASA communities. One of the new office's major functions is to transfer technology into the commercial sector at a faster pace than in the past.

"We will seek the input of the technology user community to figure out the best mechanisms to transfer technology, whether it's technical papers, NASA-generated software, regional tech transfer centers, cooperative research agreements or working in our labs and other facilities," Goldin said.

- end -

EDITOR'S NOTE: The report Special Initiatives Team on Technology Transfer is available to media by calling the NASA Headquarters Newsroom on 202/358-1600.

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RELEASE: 93-10

SPACE STATION PRECURSOR WORK CONTINUES ON SHUTTLE IN 1993

With launch of the first element of Space Station Freedom just 3 years away, NASA will continue to use the Space Shuttle fleet in 1993 for research associated with assembly and operation of this permanent, international laboratory in low-Earth orbit.

The space station program is on schedule to complete its first critical design review (CDR) in June. The CDR is a major program milestone. It marks a commitment on the part of space station program managers to proceed from the design stage to the fabrication and acquisition of flight hardware and software. The CDR includes the review of thousands of engineering drawings and other design documents by NASA and contractor technical personnel.

"We are quickly approaching the point in space exploration where astronauts will be conducting valuable research on a permanent basis," said Space Station Director Dick Kohrs. "In the years to come, we are going to use the Space Shuttle to give us additional research capability and confidence in the techniques to be used aboard Freedom."

Beginning with the first Shuttle flight in January and ending with the eighth mission in December, astronauts will conduct spacewalks, materials and life sciences research in the Spacelab scientific laboratories and small-scale experiments to prepare for long-duration stays in space aboard Freedom.

Spacewalks will be conducted on at least three flights in 1993 to better prepare astronauts for station assembly and maintenance. Endeavour's maiden voyage in May 1992 demonstrated the complexity and unknowns associated with manipulating large objects in space when astronauts rescued the Intelsat spacecraft and experimented with space station assembly techniques.

- more -

Future spacewalks are designed to help planners better predict the length of specific tasks during each spacewalk and to investigate the use of handrails and foot restraints while maneuvering equipment similar to that being designed for Freedom.

Endeavour (STS-54) -- January

Astronauts will conduct extravehicular activities (EVA) that can be applied to station assembly and maintenance. Some of these activities include using large tools, moving about the payload bay both with and without foot restraint devices and handling large objects in the weightless environment of spaceflight.

One of Endeavour's electricity-generating fuel cells will be shut down for 10 hours and restarted on the STS-54 mission. This will demonstrate for the first time a capability required to certify the Shuttle for long duration stays at the Freedom.

This flight also will serve as the first for a space station precursor experiment called the Application Specific Preprogrammed Experiment Culture System (ASPECS), designed as a cell growth and maintenance device to support cell biology research and improve existing bioreactor technology. The culture chamber will serve as a testbed to demonstrate movement of a fluid through the unit to provide constant nutrients to growing cells.

ASPECS will fly again on STS-57 as a full-up experiment to grow cancer cells that can be studied on return to Earth.

Columbia (STS-55) -- February

The first Spacelab module flight of 1993 is a German-sponsored mission to continue studies in materials and life sciences research to further technology development for use in the space station era. This second in a series of dedicated flights for Germany -- called SL-D2 -- is scheduled to last 9 days and follows the first German Spacelab mission flown in October 1985 aboard Challenger.

Discovery (STS-56) -- March

Atmospheric Laboratory for Applications and Science is the second in a series of missions to measure the long-term variability in the total energy radiated by the sun and study its interaction with Earth's atmosphere. The first ATLAS flight was aboard Atlantis in March 1992. This Spacelab mission uses pallet-mounted hardware in the Shuttle payload bay to study the Earth's atmosphere and variables in the solar spectrum.

Also included on this flight is ODERACS or Orbital Debris and Radar Calibration Spheres. This experiment will help calibrate ground-based instruments used to track orbital-debris. Three pairs of precisely-machined metal spheres of different diameters will be released from a canister in the payload bay.

The spheres will be tracked by ground radars to more accurately calibrate the radars. This will allow a better determination of life expectancy of space debris, assisting in the development of Freedom's protective shield. ODERACS was flown on STS-53 in December 1992, but a loss of battery power inside the canister prevented release of the spheres.

Endeavour (STS-57) -- April

The primary mission objective is to fly the first Spacehab middeck augmentation module and retrieve the European Retrievable Carrier deployed from Atlantis on the STS-46 mission in August 1992.

Spacehab is a pressurized module that more than doubles the amount of middeck locker space available to scientists for smaller, "secondary" experiments to be monitored by the crew.

The Application Specific Preprogrammed Experiment Culture System (ASPECS) will be flown as a full-up experiment on this mission to grow larger, high fidelity tissue cells for clinical research. STS-57 will carry cancer cells to be grown in the chamber and brought back for study.

On the ground, cells tend to lose their neutral buoyancy or ability to remain suspended in the nutritional fluids inside the chamber. In space, however, the cells can grow larger without floating toward the chamber walls. On the Shuttle, ASPECS will serve as the "foundation experiment" for the development of bioreactor technology on the space station. Growing cells to full maturity may take several months, which only can be done on long-duration flights aboard the station.

Spacehab also will carry a space station flight experiment called the Environmental Control and Life Support Systems Flight Experiment, containing two critical components of Freedom's environmental control system.

This is being considered as another spacewalk flight to continue proficiency training for space station assembly and maintenance later this decade. Current plans call for a spacewalk to occur on this mission or on STS-51 in July or on both. The spacewalks will include proficiency training and will demonstrate deploy and retrieval techniques to support space station assembly and maintenance.

In addition, STS-57 will carry a Getaway Special canisters rack in the payload bay including small scale experiments to help in the development and operation of the space station. Experimenters will conduct investigations in gas transfer from one tank to another, plant growth, effects of microgravity and radiation on bacteria and in cleaning and purifying effluents for long-duration space usage.

Discovery (STS-51) -- July

In addition to the primary tasks of deploying the Advanced Communications Technology Satellite and the Orbiting Retrievable Far and Extreme Ultraviolet Spectrometer-Shuttle Pallet Satellite, the crew of STS-51 will expose various materials to the space environment.

The Limited Duration Space Environment Candidate Materials Exposure experiment will expose these materials to the atomic oxygen prevalent in low-Earth orbit. This will help determine which materials are best for use in future spacecraft design, including the space station, to ensure long-term survivability in space. Freedom is designed for a minimum 30-year life.

This flight is being considered for another spacewalk to continue proficiency training for space station assembly and maintenance. Current plans call for EVAs to occur on either this mission or on STS-57 in April, or both.

Columbia (STS-58) -- August

The third Spacelab flight of 1993 will include a pressurized module on a 13-day mission. The SLS-2 Spacelab Life Sciences mission is the second devoted exclusively to understanding how the human body reacts and adapts itself to the space flight environment. This science is of particular interest since plans call for astronauts to live aboard Freedom for periods of 90 days or more.

The first SLS mission flew for 9 days in June 1991 aboard Columbia, conducting a wide array of medical tests on the crew to evaluate how they adapt to the microgravity environment of space. SLS-2 will continue these medical evaluations.

This will be the second "extended duration" Shuttle mission. STS-50 in June 1992 lasted 14 days and is the longest Shuttle mission to date. SLS-2 will continue the process of certifying the Shuttle to conduct longer duration flights docked to Freedom.

Discovery (STS-60) -- November

The second Spacehab flight will carry a large complement of secondary experiments in the additional middeck locker space. The module is attached to the orbiter's airlock and more than doubles the space to conduct secondary materials and life sciences investigations as precursor experiments to those that will fly on Freedom.

STS-60 also will carry the Wake Shield Facility (WSF) designed to be released from the payload bay to create an atomic oxygen wake as it circles the Earth -- in essence, an orbiting vacuum chamber. WSF will create its own vacuum chamber to produce extremely pure materials, atom by atom, by growing thin film crystals on an atomic template. Uses of such pure materials range from microelectronics to lasers and superconductivity.

Attached to the WSF will be a series of experiments to help study this "space wake" and the effects it has on them. One of these experiments will use the Shuttle thruster jets to "plume" or fire in the direction of the WSF to understand how the jet firings affect other spacecraft. This is important in determining what protective measures need to be addressed for the space station since the Shuttle will rendezvous with the orbiting laboratory up to four times a year later this decade.

A Russian cosmonaut will be among the crew members aboard Discovery for STS-60. A series of medical evaluations will further investigate the adaptation of the human body to space flight as well as readaptation to the Earth environment. These joint experiments with Russia will study spatial orientation, neurosensory, sensory-motor and perceptual functions, equilibrium control and eye response tests during and after the flight.

Endeavour (STS-61) -- December

The final mission of 1993 highlights the first servicing mission to the Hubble Space Telescope (HST). Three spacewalks are planned with provisions for two more to repair and service the HST launched in April 1990 aboard Discovery. The work scheduled, as well as the number of spacewalks, will provide further data for those required during the space station era for experiment monitoring and changeout as well as for maintenance

Other space station precursor experiments are being evaluated as smaller scale experiments for several of the flights scheduled this year.

- end -

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For Release

January 12, 1993

RELEASE: 93-11

LEE NAMED NASA PROCUREMENT CHIEF

NASA Administrator Daniel S. Goldin today announced the appointment of Deidre A. Lee as Acting Associate Administrator for Procurement. Lee replaces Don G. Bush who announced his intention to leave NASA in November 1992.

"Deidre Lee brings experience, considerable skills and boundless energy to this position at a time when NASA procurement activities are undergoing dynamic reform," Goldin said.

Lee had been serving as Deputy Assistant Administrator for Procurement since September 1992. Prior to that she was the Executive Officer to NASA's Acting Deputy Administrator. Earlier, she managed a variety of procurement activities in both NASA and the Air Force.

Before joining the NASA Johnson Space Center, Houston, in 1984, Lee was involved in major Air Force procurement activities for the systems and logistics commands and for the Pacific Air Forces. At Johnson, she served in numerous acquisition positions with her final assignment being Chief of Space Shuttle procurement.

Coming to NASA Headquarters in April 1991, Lee became Deputy Director of the Advanced Procurement Planning Division where she managed policy development, coordinated agency procurement initiatives and represented NASA on several internal and external teams studying key procurement issues. She also served as Special Assistant to the Assistant Administrator for Procurement.

Lee has a masters degree in public administration from the University of Oklahoma and attended the Middle Management Program of the Graduate School of Management of Simmons College, Boston.

-end-

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For Release
January 15, 1993

RELEASE: 93-012

EARTH'S ROTATION RATE MAY BE DUE TO EARLY COLLISIONS

Early in the formation of the Earth, collisions with rocks as large as Mars could have caused the Earth's rapid spin, according to the theory of a scientist at NASA's Ames Research Center, Mountain View, Calif.

Without the large impacts, the Earth would rotate only every 200 hours instead of the 24 hours it takes today, says Dr. Luke Dones, a visiting Assistant Research Astronomer from the University of California at Santa Cruz.

"Earth -- along with Mercury, Venus and Mars -- was formed about 4.5 billion years ago when solid objects collided and merged to make larger objects," Dones said.

"When these objects strike a forming planet, they can make it spin, just as you can make a globe spin by pushing it with your finger," said Dones.

Dones and his research partner studied the histories of collisions during the formation of Earth to see what the "spin speed" would be.

"We found that if Earth had been formed from only small objects, like the asteroids we see today, it would spin very slowly," Dones said.

"When objects struck the Earth, most of the spin came from one or more giant impacts," he said. "They didn't cancel each other out like the smaller impacts, thus the net spin is much more rapid."

"On the average, the larger the bodies that hit the Earth, the faster the spin it was given. From the rate at which the Earth does spin, we believe something about the size of Mars struck Earth during the late stages of its formation," Dones said. Mars is one-tenth the size of Earth.

- more -

According to this theory, the fact that the Earth turns on its axis in roughly the same direction that the planet orbits the sun is somewhat a matter of chance.

"We think it's equally likely that a planet can form with the opposite spin direction, so that the sun would rise in the west and set in the east," Dones said.

And, in fact, Venus does spin "backward," and Uranus spins on its side. "The spins of both planets also could be the results of giant impacts," Dones said.

He said the existence of the moon also could be a result of a very large collision during the formation of the early Earth. The origin of the moon has been a puzzle for a long time, Dones said.

"A popular theory holds that the collision of a Mars-sized planetary body with the Earth threw considerable debris into orbit, which then came together to form the moon," Dones said. "Thus, the same impact which gave Earth its spin, could also have formed the moon."

Dones conducted the research during a 2-year period with Dr. Scott Tremaine, Director of the Canadian Institute of Theoretical Astrophysics in Toronto. Their theory will be published in the Jan. 15 edition of Science, the weekly journal of the American Association for the Advancement of Science.

- end -

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202 453-8400

ISY

For Release

Paula Cleggett-Haleim
Headquarters, Washington, D.C.
(Phone: 202/385-0885)

January 19, 1993

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RELEASE: 93-14

1992 ANTARCTIC OZONE DEPLETION AS SEVERE AS ANY PREVIOUS YEAR

Continuing observations by the Nimbus-7 and Meteor-3 Total Ozone Mapping Spectrometer (TOMS) instruments have confirmed that the depletion of stratospheric ozone over Antarctica in 1992 was as severe as any previous year.

In 1992, the "ozone hole" developed 1 to 2 weeks earlier than prior years. NASA scientists at Goddard Space Flight Center, Greenbelt, Md., also have confirmed that on Sept. 23, 1992, the Antarctic ozone hole was the largest on record.

On that date, the surface area of the ozone hole reached 8.9 million square miles (24.35 million square kilometers), but fell off to less than 7.7 million square miles (20 million square kilometers) in early October. For comparison, the surface area of the North American continent is 9.4 million square miles.

This past year's Antarctic ozone depletion was comparable to the 1990 ozone depletion in duration and depth, NASA scientists report. The 1992 ozone hole breakup began in early December, later than the normal mid-to-late November break-up. Late break-ups also occurred in 1987 and 1990.

The hole, or area of ozone depletion, was still present as late as Nov. 30, 1992, when levels were still below 220 Dobson Units and the size was 1.7 million square miles (4.5 million square kilometers).

- more -

TOMS measured a record low of 110 Dobson Units on Oct. 6,1991. The lowest value reached in 1992, 124 Dobson Units, occurred on Sept. 27. However, this value is uncertain because balloon measurements found that ozone in the lowest part of the stratosphere was unusually low in 1992. It is possible that the actual value could have been as low as in 1991.

The "ozone hole" is a large area of intense ozone depletion, below 220 Dobson units, over the Antarctic continent that typically occurs between late August and early October and typically breaks up in mid-November. One hundred Dobson Units equals a layer of gas one millimeter thick at the surface. Scientists have shown that man-made chlorine is the primary cause of ozone hole formation.

The 1992 Antarctic ozone depletion also may have been affected by the continued presence of sulfuric acid droplets in the upper atmosphere created by the June 1991 eruption of Mount Pinatubo in the Philippines.

This data from the TOMS instrument onboard NASA's Nimbus-7 satellite is consistent with that of the TOMS onboard the Russian Meteor-3 satellite launched in August 1991. Both TOMS instruments are managed by Goddard for NASA's Office of Space Science and Applications, Washington, D.C.

-end-

Editors Note: Two photographs are available to media representatives through NASA's Broadcast and Imaging Branch, 202/358-1900. The photo numbers are:

B&W	Color
93-H-6	93-HC-5
93-H-7	93-HC-6

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For Release
January 21, 1993

RELEASE

NASA-WISCONSIN EXPERIMENT LINKS X-RAYS TO SUPERNOVA

Analyzing preliminary data from a NASA-University of Wisconsin instrument aboard the Space Shuttle Endeavour, astrophysicists have obtained the first direct evidence that mysterious x-rays from deep space emanate from clouds of invisible, super hot gas.

Many scientists believe the clouds of ionized, extremely hot gas were produced long ago by cataclysmic supernova explosions.

Using a detector known as the Diffuse X-ray Spectrometer (DXS), astrophysicists from the University of Wisconsin-Madison sampled faint x-rays that appear to be a signal from a supernova event that occurred in the vicinity of Earth's solar system.

Since the beginning of X-ray astronomy in the early 1960s, scientists have puzzled over the origins of the low-energy X-rays that emanate from seemingly empty space, including a huge region around our solar system.

If scientists' ideas of how these enormous pockets of superheated gas came to be are correct, then the x-ray signal detected by DXS may be coming from gas heated by the blast wave of a supernova, said Dr. Wilton T. Sanders of the University of Wisconsin-Madison, the DXS' Principal Investigator.

-more-

That supernova, which occurred approximately 300,000 years ago, likely created a pulsating star known as Geminga as well as an expanding pocket of superhot x-ray-emitting gas that now surrounds Earth's solar system and extends for several hundred light years in all directions.

Recent observations from the German-American xX-ray satellite ROSAT and NASA's Compton Gamma Ray Observatory identified Geminga as a pulsar, a very dense, rapidly rotating species of star associated with supernova events.

"What we are seeing is like an echo from the past," said Sanders. "For 30 years, scientists have speculated about the origins of these x-rays and now this echo, these faint x-rays that we're looking at, are starting to give us some answers."

The x-rays being deciphered by the Wisconsin scientists seem to underpin a theory put forward 20 years ago by UW-Madison scientists that the x-rays are produced in vast clouds of superhot, ionized gas heated by supernova explosions in our galaxy.

"We're looking at objects that are so hot they glow in x-rays, " said Sanders. "They're hotter than white hot, they're hotter than blue hot. They're X-ray hot, and that means the temperatures of these clouds are something on the order of a million degrees."

In addition to scanning the sky in the direction of Geminga, the DXS detectors -- a pair of extremely sensitive X-ray spectrometers mounted on opposite sides of Endeavour's cargo bay -- swept other regions of space. There they detected x-rays who signature looks distinctly different from that of Geminga and could possibly be from a far older supernova event.

That supernova, which probably occurred millions of years ago, created a similar gas bubble that is now much bigger than the one that may have been caused by the supernova that created Geminga.

"So what we may be seeing with Geminga is the creation of a gas bubble within a gas bubble," said Sanders. "The effect of Geminga would be to reheat and, if it exploded near the edge of this region, enlarge the existing cavity in one direction."

Sanders cautioned that while the DXS data look good, the data are still preliminary and will require extensive analysis before tbeing presented to the scientific community.

High counts of high-energy particles initially led to some problems with the instrument early in the flight of STS-54, launched from the Kennedy Space Center, Fla., on Jan. 13. However, by purging the detectors with gas and heating them, ground controllers at the Goddard Space Flight Center, Greenbelt, Md., returned the instruments to operation.

-end-

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For Release
January 22, 1993

RELEASE: C93-b

NASA MODIFIES GRAVITY PROBE-B CONTRACT

NASA has modified an existing contract with Stanford University for additional work on the Gravity Probe-B experiment. The contract modification value is $54.8 million, bringing the total contract value to $165.6 million.

Stanford is developing this relativity gyroscope experiment for NASA to test predictions of the general theory of relativity. The gyroscopes are designed to be so free of disturbances that they will provide an almost perfect space-time reference system.

Gravity Probe-B will determine how space and time are warped by the presence of the Earth and its rotation by measuring very small changes in the spin of four gyroscopes in a satellite at 400 miles (644 km) altitude in a Earth polar orbit.

Stanford has been working to develop and test a prototype science payload on the ground and to develop and test a preliminary configuration of the science mission instrument package aboard the Space Shuttle.

The contract modification calls for enhanced systems testing and performance verification of both the ground and Shuttle test units. It adds ground test hardware and a second engineering flight test unit.

The modification extends the contract, which began in 1985, for 33 months. The first Shuttle test flight is scheduled for October 1995.

The principal place of work performance will be Stanford University's facility in Stanford, Calif. The Marshall Space Flight Center, Huntsville, Ala., is managing Gravity Probe-B for NASA's Office of Space Science and Applications, Washington, D.C.

- end -

NASA News

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For Release
January 26, 1993

NOTE TO EDITORS: N93-4

STS-55 SPACE SHUTTLE MISSION BRIEFINGS SET

The STS-55 preflight briefings will be held Feb. 3 and 4 at the Johnson Space Center, Houston, building 2, room 135.

A briefing agenda is attached. All briefings will be carried on NASA Select television with two-way audio for questions from NASA Headquarters and other centers. NASA Select programming is carried on SATCOM F2R, transponder 13, located at 72 degrees west longitude.

-end-

AGENDA
STS-55 PREFLIGHT BRIEFINGS
February 3-4, 1993
All Times EST

WEDNESDAY, Feb. 3

9:30 a.m. Mission Overview
Gary Coen, Lead Flight Director, JSC
Dr. H. Dodeck, D-2 Mission Manager,
German Aerospace Research Establishment (DLR)

10:30 a.m. DLR Science Overview
Materials Science - Dr. P. R. Sahm, D-2 Program Scientist
University of Aachen, Aachen, Germany
Technology Astronomy - Dr. M. Keller, D-2 Project Scientist,
DLR, Cologne, Germany
Human Physiology - Dr. J. Stegemann,
University of Cologne, Cologne, Germany
Fluid Physics - Dr. D. Langbein, Battelle-Institute, Frankfurt
Biology - Dr. H. D. Mennigmann, University of Frankfurt

12:00noon NASA Science Overview
Enhanced Hybridoma Production Under Microgravity
- Dr. David W. Sammons, PI, University of Arizona, Tucson
Influence of Weightlessness upon Autonomic Cardiovascular Controls
- Dr. Dwain L. Eckberg, PI, Medical College of Va., Richmond
Cardiovascular Regulation at Microgravity
- Dr. C. G. Blomqvist, PI, University of Texas
Health Science Center, Dallas

2 p.m. Shuttle Amateur Radio Experiment (SAREX)
-Louis McFadin, JSC, Principal Investigator

THURSDAY, Feb. 4

9:00 a.m. STS-55 Crew Briefing
Steven R. Nagel, Commander
Terence T. Henricks, Pilot
Jerry L. Ross, Mission Specialist
Dr. Bernard A. Harris, Jr., Mission Specialist
Charles J. Precourt, Mission Specialist
Hans Schlegel, Payload Specialist
Dr. Ulrich Walter, Payload Specialist

-end-

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ISY

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January 26, 1993

EDITORS NOTE: N93-5

STS-54 CREW POSTFLIGHT PRESS CONFERENCE SCHEDULED

The STS-54 crew postflight press conference is scheduled for Monday, Feb. 1, at 4 p.m. EST, in building 2, room 135, at the Johnson Space Center (JSC), Houston.

Crew members will narrate slides and film from their recent mission. During their Space Shuttle flight, they deployed a communications satellite, acquired data on the remnants of a supernova in the Milky Way galaxy, performed a spacewalk, conducted more scientific experiments to help the medical community improve medical treatment here on Earth and interacted with elementary students, teaching physics lessons using toys to demonstrate various principles of motion.

News media are invited to participate at JSC or by two-way audio from NASA Headquarters and other centers. The briefing will be carried on NASA Select television, SATCOM F2R, transponder 13, located at 72 degrees west longitude.

- end -

NASA News

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For Release
January 27, 1993

RELEASE: 93-16

CROSSFIELD AWARDED NASA DISTINGUISHED PUBLIC SERVICE MEDAL

NASA Administrator Daniel S. Goldin awarded famed test pilot A. Scott Crossfield the NASA Distinguished Public Service Medal for his contributions to aeronautics and aviation during a 50 year career. The award was presented in a Capitol Hill ceremony honoring Crossfield's retirement from federal service yesterday.

Crossfield played a pivotal role in NASA's highly successful X-15 research aircraft program in the late 50s and early 60s. He also flew most of the early experimental X-series research planes for NASA's predecessor, the National Advisory Committee for Aeronautics (NACA).

More recently, he has been a key advocate of the National Aero-Space Plane (NASP) program as technical consultant to the U.S. House of Representatives Committee on Science and Technology.

"Scott's pioneering efforts with the X-series of airplanes and his contributions to the X-15 program were vital to the historic flight research accomplishments by NASA and the NACA," Goldin said. "He has continued to apply his skills and talents to aeronautics with his visionary advice and counsel on the NASP program and the potential it offers to the nation."

Crossfield joined NACA as a research pilot in 1950. During his 5-year stint at the NACA High-Speed Flight Station, Edwards, Calif., he flew the X-1 and D558-II rocket planes and many experimental jets. On Nov. 20, 1953, Crossfield became the first person to fly twice the speed of sound at the controls of the D558-II "Skyrocket".

As chief engineering test pilot for North American Aviation, Inc., Crossfield was the driving force behind development of the record-setting X-15 rocket research aircraft that paved the way for NASA's Space Shuttle. He guided the X-15 on its first free flight in 1959 and later qualified the first two X-15s for flight before they were turned over to NASA and the U.S. Air Force.

- more -

"I have a lot of respect for Scott. He was an excellent test pilot," said former X-15 pilot Milt Thompson, now Chief Engineer at NASA's Ames-Dryden Flight Research Facility, Edwards, Calif. "As pilot-consultant to the X-15, he contributed significantly to the safety and reliability of its design."

Crossfield served as an executive for Eastern Airlines from 1967 to 1973, where he helped shape the company's technology applications, new aircraft specifications and flight research development. From 1974 to 1975, he was Senior Vice President with Hawker Siddley Aviation and established its U.S. subsidiary for design, support and marketing of the HS-146 transport in North America.

From 1977 until his retirement, Crossfield was technical consultant to the House Committee on Science and Technology, where he advised committee members on all aspects of civil aviation. He has been a strong supporter of the NASP program to develop a flight research vehicle that will take off horizontally, fly into Earth orbit and return through the atmosphere to land on a runway.

-end-

NASA News

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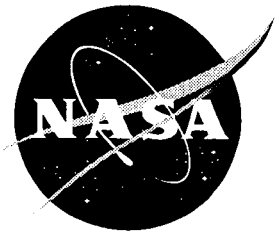

For Release

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January 28, 1993

RELEASE: 93-17

NEW ADVISORY GROUP EYES MINORITY BUSINESSES

Members of NASA's newly-chartered Minority Business Resource Advisory Committee opened a new era of multicultural participation in the civil space program when they met here this week to discuss their charter and begin developing an agenda for action.

The committee was formed by NASA Administrator Daniel S. Goldin partially in response to a directive by Congress to award 8 percent of the total value of the agency's prime and subcontracts to economically and socially disadvantaged businesses and minority educational institutions involved in key NASA activities.

Goldin met with the committee, consisting of representatives of minority and women-owned businesses around the country, and charged them with establishing a vision and strategic plan to carry out their objectives and measure their progress.

The group plans to meet quarterly at various NASA field centers to address issues such as training programs, procurement practices and outreach programs. The committee's recommendations will be facilitated through the Office of Small and Disadvantaged Business Utilization, headed by Associate Administrator Ralph C. Thomas, III.

- end -

NASA News

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For Release

January 29, 1993

RELEASE: 93-18

KSC BASE OPERATIONS CONTRACT AWARD PROTESTS SETTLED

NASA announced today that the protests of EG&G Florida, Inc., BAMSI Inc., and Westinghouse KSC Company, Inc. have been settled on the Kennedy Space Center (KSC) Base Operations Contract (BOC) procurement.

NASA had selected Lockheed Space Operations Co. on Nov. 17, 1992, for negotiations leading to award of the BOC. The three companies protested the selection to the General Services Administration Board of Contract Appeals in early December.

Settlement was prompted by the determination that certain deficiencies in the agency's activities occurred during the original proposal submission and discussion phase of the procurement. This resulted in a deficiency in certain critical information which remained unrequested and therefore, unavailable for NASA's source evaluation board to fully consider and evaluate.

As part of the settlement, NASA will rescind its original selection. An amendment to the BOC solicitation also will be issued. Each of the four competitors then will have the opportunity to submit a revised proposal. Selection of an awardee is expected to occur sometime during late summer.

The BOC provides a wide variety of services to KSC, primarily in the area of management, operation, maintenance and engineering for KSC facilities and utilities, technical and administrative support operations, and health, fire and security services. The BOC will be a cost-plus-award fee contract, with an incentive fee feature, for an initial period of 4 years with three priced 2-year options.

EG&G Florida, Inc., the incumbent contractor, will continue to provide base operations support during the recompetition period.

-end-

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For Release
February 1, 1993

RELEASE: 93-019

NASA PRESENTS PUBLIC SERVICE MEDAL TO GENE RODDENBERRY

Gene Roddenberry, creator of the Star Trek television series, posthumously received NASA's Distinguished Public Service Medal on Jan. 30. The medal was presented to his widow, Majel Barrett Roddenberry, by NASA Administrator Dan Goldin in a ceremony at the Smithsonian's National Air and Space Museum in Washington, D.C.

Roddenberry is credited with popularizing the exploration of space through the original Star Trek television series, six motion pictures and the spin-off television series Star Trek: The Next Generation. His vision of a positive future for the human race, as well as the social and artistic content of the series, have enjoyed enormous success and popularity since the original Star Trek premiered on television in 1966.

The impact of his program was recognized in the U.S. space program as the first Space Shuttle was named Enterprise after the spaceship in Star Trek. Many people, including astronauts and others involved in the space program, cite Star Trek as being an early influence on their lives.

The citation accompanying the medal reads: "For distinguished service to the Nation and the human race in presenting the exploration of space as an exciting frontier and a hope for the future."

Gene Roddenberry died in October 1991.

- end -

93-20

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION
STS-55

PRESS KIT

FEBRUARY 1993

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CREW BIOGRAPHIES & MISSION MANAGEMENT

RELEASE: 93-20 February 1993

SECOND GERMAN SPACELAB MISSION IS SPACE SHUTTLE'S 54TH FLIGHT

The 54th flight of the Space Shuttle will be devoted primarily to Germany for conducting a wide range of experiments in the microgravity environment of space flight.

Columbia, the flagship of the Shuttle fleet, will make its 14th voyage into Earth orbit carrying a crew of seven, including two German payload specialists. STS-55's primary payload is Spacelab D2, for the second Shuttle mission dedicated to Germany. Spacelab D1 was flown in 1985. Spacelab is a self-contained, space-based research laboratory carried inside the Shuttle's 60-foot-long cargo bay.

The seven member crew is a mix of veterans and first-time space travelers. Commander Steve Nagel and mission specialist Jerry Ross will both be making their 4th trip into orbit. STS-55 will mark Pilot Tom Henricks' second flight. Mission specialist Charles Precourt and Bernard Harris will be making their first space flights, as will the two German payload specialists Ulrich Walter and Hans Schlegel.

Mission management resides in the German Aerospace Research Establishment (DLR), the scientific program responsibility in the German Space Agency (DARA). Payload control and operation during the mission are handled by DLR's Space Operation Control Center (GSOC) at Oberpfaffenhofen near Munich, Germany.

Columbia is scheduled to be launched from the Kennedy Space Center (KSC), Fla., in late February. The mission is planned for 9 days with a landing at KSC.

Some 90 experiments are planned during the mission. The 7-member crew will be divided into two teams, red and blue, so that science operations can be carried out around the clock.

Most of the experiments have been provided by the German Space Agency and the European Space Agency (ESA). Japan has provided a number of experiments, and NASA is furnishing 3 experiments for this mission.

In addition to developing the concept of Spacelab itself, ESA will fly a total of 21 experiments. and participate in 11 experiments. Five are contained in the Advanced Fluid Physics Module and 19 are placed in the unique equipment facility, called Anthrorack, for human physiological research in microgravity. Six other experiments are in the field of materials synthesis and two flight experiments are for the future Columbus Attached Pressurized Module, which will form part of the international Space Station Freedom.

NASA also is flying its "ham" radio experiment, SAREX, which will enable Nagel and Ross to talk to schools and amateur radio enthusiasts on the ground. Both German payload specialists are licensed ham radio operators as well and will be operating their own ham system called SAFEX.

One payload that had been manifested on STS-55, BREMSAT, was removed prior to launch and will be reflown later this year. The payload was to have been deployed into space from a getaway special canister (GAS) to detect micrometeorites in near-Earth orbit and to measure cosmic dust. NASA mangers delayed the flight of the BREMSAT because problems with another GAS-deployed payload flown on STS-53 have not been satisfactorily resolved.

Most of the Spacelab D2 experiments will explore the behavior of humans, other living organisms and materials when the force of gravity is essentially removed.

"Our scientific methods, like our everyday behavior, are governed by a natural condition - the effect of gravity," said DLR's Spacelab D2 Project Manager Dr. Hauke Dodeck. "Objects fall down, lighter materials float or are carried upwards, heavier ones sink to the bottom.

"What happens to these processes when there is no gravitational force, in other words: no sedimentation, no thermal convection, no hydrostatic pressure? What new mixtures, structures and forms are possible?" he posed. "Concrete answers to such questions can be given only by space research."

D2 experiments will be carried out in 6 major scientific disciplines: materials sciences, biological sciences, technology, Earth observations, atmospheric physics and astronomy. Most of the experiments are contained in racks, about the size of a side-by-side refrigerator, inside the Spacelab module. A special fixture, called the Unique Support Structure, has been placed in Columbia's cargo bay. Astronomy, Earth-observing instruments and materials which require direct exposure to space are mounted to this structure.

In the materials sciences field, among the experiments to be performed are those involved in growing semiconductor materials. For this mission, the material will be gallium arsenide - a semiconductor of great importance for electronic applications. The objective is to produce crystals of high quality and large size. It is expected that the results will contribute to the improvement of terrestrial crystal growth methods.

The Material Sciences Laboratory will be the site for experiments on alloys and for experiments which use the microgravity environment to produce single-crystal bodies of a shape similar to a turbine blade.

"If the tests produce the hoped-for results," said Dodeck, "turbine blades can be developed which are strongly resistant to heat and stress, thereby improving the performance and lifetime of aircraft engines."

An experimental facility called the Holographical Optical Laboratory (HOLOP) will use holography to gain insight into processes of heat and mass transfer and of cooling in transparent materials which are of great interest for reserarch into metallurgy and casting.

"HOLOP will transmit video pictures of experiments to the ground while they are being performed," Dodeck explained. "Scientists on Earth can not only watch what happens, but also may intervene in the test sequence, thus demonstrating a concept called telescience." The telescience experiment will be carried out from DLR's Microgravity Life Support Center (MUSC) at Cologne-Porz.

Other experiments will focus on protein crystal growth and biology. One experiment will use electrical impulses in an attempt to fuse cells to create hybrids. The results will advance both basic and applied research.

An experiment called the Statolith Experiment will study the development of balance-sensing organs in tadpoles of the South American clawed frog and larvae of a type of colored perch. An understanding of how those sensors develop, when not influenced by gravity, could lead to new insights into the causes of space sickness.

"D2 will use the human body as a test subject," said Dodeck. "A special medical research facility on this flight, called Anthrorack, is the most advanced of its type which has flown in space."

Some 20 different experiments will be performed in the facility, ranging from investigations on body organs and their controlling mechanisms, control of heart and blood circulation, to the functions of the lungs. In addition, a multitude of physiological processes will be observed.

A robotic technology experiment, called ROTEX, will gather basic experience on how a robot can operate in microgravity. A robot arm with 6 joints will perform a variety of tasks, including building a small tower of cubes and retrieving a small object floating in space. The robot can be operated from onboard or by scientists on the ground. Both modes will be tested.

Investigations on the effects of radiation upon organisms also will be studied. Astronauts will wear radiation detectors. Other detectors will be placed near biological experiments as control indicators. The results will contribute to the assessment of the biological effects of specific cosmic radiation, which will help reduce the health risks for future missions.

Part of the ongoing preparations for the assembly and operation of Space Station Freedom, over 200 samples of different materials will be placed on the support structure in the payload bay to gather data on interaction with atomic oxygen. The goal is to examine how different materials - polymers, compounds and organic films - stand up to atomic oxygen which is of keen interest to builders of the orbiting outpost which will be in space at least 3 decades.

Another instrument mounted outside, called MOMS, will obtain data to enable topographical maps to be produced by automatic data evaluation processes for the first time. A spherical mirror camera, GAUSS, which also is fixed to the payload bay structure, will take pictures in six spectral bands of all parts of the Milky Way, thereby extending the knowledge of the galaxy.

-end of general release-

MEDIA SERVICES INFORMATION

NASA Select Television Transmissions

NASA Select television is available on Satcom F-2R, Transponder 13, located at 72 degrees west longitude; frequency 3960.0 MHz, audio 6.8 MHz.

The schedule for television transmissions from the Shuttle orbiter and for the mission briefings will be available during the mission at Kennedy Space Center, Fla; Marshall Space Flight Center, Huntsville; Ames-Dryden Flight Research Facility, Edwards, Calif.; Johnson Space Center, Houston, and NASA Headquarters, Washington, D.C. The television schedule will be updated to reflect changes dictated by mission operations.

Television schedules also may be obtained by calling COMSTOR 713/483-5817. COMSTOR is a computer data base service requiring the use of a telephone modem. A voice update of the television schedule is available daily at noon EST.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA newscenter.

Briefings

A mission press briefing schedule will be issued prior to launch. During the mission, status briefings by a flight director or mission operations representative and when appropriate, representatives from the science team will occur at least once per day. The updated NASA Select television schedule will indicate when mission briefings are planned.

D2 NEWSROOM OPERATIONS

A D2 mission news center will be established at DLR's Operations Control Center/German Space Operations Center (GSOC) at Oberpfaffenhofen, where mission science operations will be controlled. Media work space and facilities will be available on a limited basis and will be allocated on a daily first-come, first-served basis.

News media planning to cover the mission from the D2 news center should contact DLR's Public Affairs Office, Linder Hohe, 5000 Koln-Porz, by writing or sending a request via fax at (02203) 601-3249.

Operating Hours

The D2 news center will be open from 9 a.m. untill 6 p.m. local time. Media which plan mission related reports early in the morning will have access to the news center and will be provided with pertinent information. Media will have access to mission timing and tracking displays.

Staffing

The D2 news center will be staffed by DLR public affairs officers, by public affairs officers representing the German Space Agency, the European Space agency, the German space industry, NASA and other experts. An interview desk in the news center will arrange and schedule interviews with mission participants.

Briefings, Status Reports And Press Releases

D2 status briefings will originate from the D2 news center at 12:30 p.m. local time, daily throughout the mission. Status reports and press releases in German will be issued once daily at 1 p.m. local time. English translations will be provided soon after release.

Mission Television

Coverage emanating from GSOC will include television from Spacelab and Space Shuttle and its payload bay and from the Payload Control Rooms in Oberpfaffenhofen and special programming. Special programming includes video highlights as well as comments and interviews by mission participants.

The "All-TV" program will originate from GSOC and will be distributed by Deutsche Bundespost/Telekom. "All-TV" is available on DFS Kopernikus 2, Transponder A2, located at 28.5 degrees, best downlink fequency 11.525 GHz. The transmission is scheduled from 11 a.m. to 5 p.m.

STS-55 QUICK LOOK

Launch Date/Site:	Feb. 25, 1993/Kennedy Space Center, Fla. Pad 39A
Launch Time:	10:20 a.m. EST
Orbiter:	Columbia (OV-102) - 14th Flight
Orbit/Inclination:	160 nautical miles/28.45 degrees
Mission Duration:	8 days, 22 hours, 2 minutes
Landing Time/Date:	8:25 a.m. EST/March 6, 1993
Primary Landing Site:	Kennedy Space Center, Fla.
Abort Landing Sites:	
Return to Launch Site	Kennedy Space Center, Fla.
TransAtlantic Abort	Banjul, The Gambia Ben Guerir, Morroco Moron, Spain
Abort Once Around	Edwards AFB, Calif. Kennedy Space Center, Fla. White Sands, N.M.
Crew:	Steve Nagel, Commander (CDR) Tom Henricks, Pilot (PLT) Jerry Ross, Mission Specialist 1 (MS1) Charles Precourt, Mission Specialist 2 (MS2) Bernard Harris, Jr., Mission Specialist 3 (MS3) Ulrich Walter, Payload Specialist 1 (PS1) Hans W. Schlegel, Payload Specialist 2 (PS2)
Blue Team:	Nagel, Henricks, Ross, Walter
Red Team:	Precourt, Harris, Schlegel
Cargo Bay Payloads:	Spacelab D2 Reaction Kinetic in Glass Melts GAS
In-Cabin Payloads:	Shuttle Amateur Radio Experiment-II

STS-55 ORBITAL EVENTS SUMMARY

Event	Elapsed Time	Velocity Change	Orbit (n.m.)
Launch	00/00:00:00	N/A	N/A
OMS-2	00/00:42:00	220.9 fps	160 x 162
Deorbit	08/21:05:00	TBD	N/A
Landing	08/22:05:00	N/A	N/A

STS-55 VEHICLE AND PAYLOAD WEIGHTS

Vehicle/Payload	Pounds
Orbiter (Columbia) empty and 3 SSMEs	181,034
Spacelab D-2	25,025
RKGM	200
RKGM GAS Support Equipment	190
SAREX-II	24
Total Vehicle at SRB Ignition	4,518,724
Orbiter Landing Weight	227,494

STS-55 SUMMARY TIMELINE

Flight Day One
Launch
OMS-2
Spacelab-D2 activation

Flight Day Two
Spacelab-D2 operations
SAREX-II set-up

Flight Day Three
Spacelab-D2 operations

Flight Day Four
Spacelab-D2 operations

Flight Day Five
Spacelab-D2 operations

Flight Day Six
Spacelab-D2 operations

Flight Day Seven
Spacelab-D2 operations

Flight Day Eight
Spacelab-D2 operations

Flight Day Nine
Spacelab-D2 operations
Reaction Control System hot-fire
Flight Control Systems checkout
Medical DSOs

Flight Day Ten
SAREX deactivation
Spacelab-D2 deactivation
Cabin stow
Deorbit burn
Entry
Landing

SPACE SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, orbiter and its payload. Abort modes include:

* **Abort-To-Orbit (ATO)** -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical-mile orbit with orbital maneuvering system engines.

* **Abort-Once-Around (AOA)** -- Earlier main engine shutdown with the capability to allow one orbit around before landing at either Edwards Air Force Base, Calif., White Sands Space Harbor, N.M., or the Shuttle Landing Facility at the Kennedy Space Center, Fla.

* **Trans-Atlantic Abort Landing (TAL)** -- Loss of one or more main engines midway through powered flight would force a landing at either Banjul, The Gambia; Ben Guerir, Morroco or Moron, Spain.

* **Return-To-Launch-Site (RTLS)** -- Early shutdown of one or more engines, without enough energy to reach Banjul, would result in a pitch around and thrust back toward KSC until within gliding distance of the Shuttle Landing Facility.

STS-55 contingency landing sites are Edwards Air Force Base, the Kennedy Space Center, White Sands Space Harbor, Benjul, Ben Guerir and Moron.

SPACELAB D2

Overview

The Spacelab D2 mission is the second under German mission management and responsibility. The D1 mission was conducted in November 1985 with German and European astronauts on board.

Besides continuing research areas and scientific experiments from D1, the D2 mission will be multi-disciplinary covering the fields of materials and life sciences mainly dedicated to micro-g research and also to technology, automation, robotics and Earth and space observations. Both the D1 and D2 missions are the only two Spacelab missions with payload operations control from foreign countries.

Mission management resides in the German Research Aerospace Establishment (DLR) and program management in the German Space Agency (DARA). Tasks performed by DLR are training of astronauts, flight planning and flight operations and payload control and operations. Some 16 experiments are furnished by DLR, covering the fields of material sciences, life sciences, robotics (ROTEX) and earth observation (MOMS-02). DASA/ERNO Raumfahrttechnik is responsible for payload integration, including preparation, corresponding tests and mission support.

The experimental program of the D2 mission is oriented towards the goals of the space utilization program of the Federal Republic of Germany and also of the microgravity program of ESA. D2 includes some 90 experiments ranging from investigations of the dynamics of the solidification boundary to the electrofusion of cells. Numerous universities, research institutes and industrial concerns in Germany and other countries, contribute to the scientific experimental program.

The cooperation with NASA goes beyond the provision of the Shuttle/Spacelab System. The experiment Baroreflex and two further investigations are supported by the U.S. agency. Furthermore ESA, CNES (France) and MITI (Japan) are taking part in the mission.

To guarantee that the D2 mission goes successfully, the payload specialists and the flight operations crew have been prepared for their tasks under "real" conditions. The cooperation between the astronauts in space and the experts on Earth has been practiced within the framework of these "integrated simulations", as they are known.

For this purpose, the astronauts were "on board" the DLR Spacelab simulator in Cologne-Porz, while the ground teams were in the DLR Space Operation Control Center in Oberpfaffenhofen. "Shuttle" and "ground" worked round-the-clock in two 12-hour shifts. Voice communication was by radio, as during the real flight.

DLR's Control Center at Oberpfaffenhofen offers scientific spaceflight a modern ground system that allows control of all the experiments. During the D1 mission, some still had to be monitored from Houston because the data transmission capacity was insufficient at that time. However, it has been expanded considerably since then, and the data transmitted via satellite are now received by ground stations on the premises of the DLR and then forwarded to the computer installations in the Control Center.

Once the data have been edited and stored, they are distributed to the computers of the experimenters in the user control rooms in real-time mode. The main data stream is forwarded to the processing system of the Control Center. It is there that telemetry and telecommand data processing, mission planning and timeline compilation are handled, as well as distribution of the roughly 10,000 parameters to the workstations in the control and user rooms.

Payload Operations

The task "payload operations" covers all activities for operation of the payload, i.e. the experiments on board and the support from ground control during the preparation and execution of the D2 mission. A large variety of activities are included:

The responsibility to operate the payload lies within the German Aerospace Research Establishment (DLR). This means that the D2 mission will be executed from two different agencies, NASA and DLR, and from two different countries, the United States and Germany. The Mission Control Center (MCC) in Houston and the German Space Operations Center (GSOC) at Oberpfaffenhofen near Munich are supporting the mission in close cooperation.

In GSOC is located the mission operation support team which includes all the experimenters/investigators and their technical industrial support. The cadre team directs the entire payload and is split into several subteams responsible for real time mission execution, replanning efforts and communication (data, voice, TV). In case of anomalies, experimenters and cadre team together to work out a solution that the astronauts in orbit will execute. The astronauts in orbit will work in two shifts around the clock, so GSOC and MCC are staffed for 24 hours a day during the 9-day mission.

Three voice loops, data channels and TV channels are available between the orbiter/spacelab and the two control centers. For communication between the two control centers, 19 voice loops, data lines, TV-lines and fax lines will be used via different satellite systems.

MATERIAL SCIENCES EXPERIMENT DOUBLE RACK FOR EXPERIMENT MODULES AND APPARATUS (MEDEA)

MEDEA is located in rack 3 of the Spacelab module and accommodates three different experiment furnace facilities. These furnaces are the Elliptical Mirror Furnace (ELLI), the Gradient Furnace (GFQ) and the High Precision Thermostat (HPT).

The Elliptical Mirror Furnace is used for long-term crystallization experiments performed in microgravity. Crystal growth is established by moving the sample along the main axis of the furnace traversing the focus. The Gradient Furnace studies material processing in microgravity by direct solidification methods using metallic crystals grown at high temperatures. The High Precision Thermostat investigates critical phenomena of metals under precisely controlled temperature conditions.

Experiments

•FLOATING-ZONE-GROWTH OF GAAS

GaAs is the most important material for high-speed electronic circuits, especially optoelectronic devices. Under 1g, only crystals of a few mm in diameter can be grown due to the unfavorable ratio of density to surface tension. In the D2 experiment, a crystal of 20mm diameter will be crystallized, allowing a quantitative evaluation of the expected reduction of the structural defects in comparison with CZ- or Bridgman-grown material.

•FLOATING ZONE CRYSTAL GROWTH OF GALLIUM-DOPED GERMANIUM

In-situ Seebeck measurements will be used to control non- stationary thermocapillary-driven flows during floating zone crystal growth of gallium doped germanium. With the first sample, the influence of growth parameters will be investigated through several runs. The results will be used to optimize the processing parameters for the second sample. Quantitative post- flight analysis of convective effects will be made through extensive measurements of micro- and macro-segregations.

•HYSTERESIS OF THE SPECIFIC HEAT CV DURING HEATING AND COOLING THROUGH THE CRITICAL POINT

During the D2 mission, CV will be measured while heating and cooling the test substance SF6 through the critical state to investigate relaxational effects. These are considered to be the dominant mechanism for the surprising results of the CV-measurements during the D1 mission. A new spherical cell, housed in the slightly refurbished High Precision Thermostat, is heated and cooled only by radiation from the surrounding shell. CV is determined by the temperature difference between the cell and the shell.

Additionally, the temperature field in the fluid is measured by several thermistors to help answer the open question of the temperature equilibration at the critical point. On line data processing during the mission provides the possibility of changing the experiment timeline if necessary.

•DIFFUSION OF NICKEL IN LIQUID COPPER-ALUMINUM AND COPPER-GOLD ALLOYS

The diffusion of nickel in liquid Cu-Al and Cu-Au alloys will be observed at 1150 1/2 C under minimized influences of convection. The aim of this work is to determine the diffusion coefficient of nickel with respect to the concentration of the solute atoms Al and Au. The concentration of the solute atoms is ranging from 0 to 5.5 at percent.

•DIRECTIONAL SOLIDIFICATION OF GE/GAAS EUTECTIC COMPOSITES

The eutectic melt in Ge-GaAs solidifies into the layered structures having varied composition of the sub-micron thickness. The microstructures thus formed are compared in the light of the effects of gravity during unidirectional solidification.

•CELLULAR-DENDRITIC SOLIDIFICATION WITH QUENCHING OF ALUMINIUM-LITHIUM ALLOYS

Critical microgravity experiments in the cellular and dendritic regimes will be carried out on aluminium-lithium alloys. Quenching at the end of the experiments will retain the tip radius and the microsegregation. Reliable data for 3D-solification with pure diffusion in the liquid phase thus will be obtained, which will be used to test the theories of pattern formation and selection, especially of the primary spacing. The comparison with 1-g samples will enable the effects of convection to be evidenced.

•DIRECTIONAL SOLIDIFICATION OF A CU-MN ALLOY

Three experiment runs of directional solidification of a Cu-Mn alloy under low gravity will be used to investigate the transition from diffusive to diffusive-convective transport within the melt in front of a planar moving solidification interface. The thermosolutal instable system also will be used to study the onset of convection with increasing instability produced by the solidification parameters and to analyze the impact of g-gitters on the transport mechanisms and the concentration of the solidified crystal. Microanalysis of the concentration of the solid will be done afterwards on metallographic cross sections and the determined variations will be corellated to the different variations of the experiment parameters.

•THERMOCONVECTION AT DENDRITIC-EUTECTIC SOLIDIFICATION OF AN AL-SI ALLOY

Following the D1 experiments with an Al-Si alloy, the influence of the silicon content and the crystallization parameters on the dendrite morphology and eutectic microstructure is investigated utilizing a close eutectic aluminium-silicon alloy.

•GROWTH OF GaAs FROM GALLIUM SOLUTIONS

The aim of this experiment is to improve the crystal quality by investigating the following objectives under reduced gravity as well as under Earth conditions:

- dopant inhomogeneities on the macro and micro scale

- crystal perfection with respect to low defect density and the distribution of defects

- crystal perfection with respect to stoichiometry and residual impurity concentration

- studies of the influence of different transport phenomena in the solution

- studies of growth kinetics and mechanisms of dopant incorporation

WERKSTOFFLABOR (WL) MATERIAL SCIENCES LABORATORY

Located in rack 8, this facility consists of five furnaces, a fluid physics module and a crystal growth module. The experiments study several areas of metal processing, crystal growth for electronics applications, fluid boundary surfaces and transport phenomena.

Facilities

Isothermal Heating Facility (IHF) is a high temperature furnace used to process metal samples that investigate a variety of topics.

Heater Facility, Turbine Blade Facility (HFT) is designed for processing special metallic alloys. The samples as processed and solidified under microgravity conditions and cast into the shape of turbine blades.

Gradient Heating Facility (GHF) provides the necessary heating and cooling for experiments investigating crystal growth, melting solidification and eutetics.

Advanced Fluid Physics Module (AFPM) is a multipurpose facility designed to enable investigations on the behavior of fluids in a microgravity environment. AFPM is an improved version of units flown on Spacelab 1 in 1983 and D1 in 1985.

High Temperature Thermostat (HTT and HTS), which consists of two identical furnaces, were developed to study diffusion processes in liquid metals under microgravity conditions.

Cryostat (CRY) attempts to grow high-quality crystals of biochemical macromolecules by diffusion of protein into corresponding saline solutions.

Experiments

•OSIRIS: OXIDE DISPERSION STRENGTHENED SINGLE CRYSTALLINE ALLOYS IMPROVED BY RESOLIDIFICATION IN SPACE

The experiment shall prove that, with an extensive elimination of the terrestrial gravity field, a single crystalline material can be produced with a finely distributed particle inclusion. The intended matrix material is a nickel-based alloy, which is to be solidified with a dispersion of yttrium oxide particles. Due to the application-oriented objectives of the project, turbine blade-shaped sample will be processed. For the remelting of shaped material, a ceramic mold skin will be applied.

An important role plays the computer-assisted simulation of the ground and flight experiments. The time-dependent crystallization parameters in the system furnace/sample are evaluated 3-dimensionally.

•IMPURITY TRANSPORT AND DIFFUSION IN INSB MELT UNDER MICROGRAVITY ENVIRONMENT

Impurity diffusion experiment for compound semiconductor, InSb, melt will use the Isothermal Heating Facility (IHF) in the D2 mission. Impurity transport and diffusion behavior in the micro-g environment will be studied using the diffusion couple method where Zn, Ga, As, Se and Te are to be selected as the impurity species. The diameter effects and the temperature dependency on diffusion will be seen in addition to the function of plug structure located at the diffusion couple edges, which is aimed to compensate the material volume change upon solid-liquid phase transformation.

•CELLULAR-DENDRITIC SOLIDIFICATION AT LOW RATE OF ALUMINIUM-LITHIUM ALLOYS

Under diffusive conditions, the deep cell-dendrite transition will be investigated by solidifying three aluminium-lithium alloys in the GHF. In nondimensional form, the data points for the primary spacing will be used to construct a 3D-representation. The microsegregation and macrosegregation of lithium will be analyzed. Also to be studied is the organization (defects, disorder) of the cellular and dendritic bidimensional arrays. The influence of convection will be deduced from a comparison with 1g samples.

•DIRECTIONAL SOLIDIFICATION OF THE LIF - LIBAF3 - EUTECTIC

The lamellar eutectic system LiF - LiBaF3 shall be directionally solidified in a gradient furnace. The influence of the growth parameters gravity, melt

composition, growth velocity and temperature gradient on the eutectic microstructure will be examined.

•SEPARATION BEHAVIOR OF MONOTECTIC ALLOYS

By directional melting of sandwich-like samples of Al-Si-Bi alloys in which Bi-droplets are dispersed, the transport mechanisms of droplets in Al-melts will be investigated. The sandwich-like samples consist of periodically arranged cylinders of an Al-Si alloy. Ahead of the melting front there exists a temperature gradient which leads to a motion of the droplets within the Al-Si matrix melt. The droplets are free to move in as much as the melting front moves in a controlled manner through the sample. The droplet free zones will lead to a strong reduction of possible scattering and coagulation events of droplets of different sizes.

Therefore, at the end of an experiment there will be enough droplets located within the molten zone. From the spatial arrangement of the droplets and a comparison with computer simulations of the whole process, conclusions shall be drawn concerning the transport of Bi droplets in a temperature gradient. The investigations are relevant for the improvement of terrestrial industrial casting processes currently being under investigation.

•LIQUID COLUMNS' RESONANCES

This experiment will measure the resonance curves of liquid columns between coaxial circular disks and to test the corresponding theoretical models. The experiment will be performed in the Advanced Fluid Physics Module (AFPM). The supporting circular disks are vibrated with varying frequency. The response of the liquid column is observed by position and pressure sensors.

It is intended to investigate two liquids differing in viscosity and surface tension and to use several liquid volumes and surface shapes. The resonance frequencies first are roughly determined by applying a frequency ramp and subsequently may be checked more accurately by frequency variation from hand. The interest in liquid columns has been stimulated by the numerous applications to crystal growth by the floating zone or travelling-heater techniques.

•STABILITY OF LONG LIQUID COLUMNS

The aim is to measure the outer shape deformation of long liquid bridges under microgravity when subjected to mechanical disturbances, namely change of geometry, rotation and vibration. This configuration has, aside of its own relevance in fluid mechanics and interface science, a well-known application in materials processing, particularly in the floating zone technique of crystal growth in the semiconductor industry.

As a spin-off of this research, this configuration has proved to be a unique accelerometer at very low frequencies. The aim is at gathering experimental

data to validate several theoretical predictions on equilibrium shapes, stability limits and dynamics of stable and unstable bridges, to provide further guidance to more realistic and complex modeling.

•HIGHER MODES AND THEIR INSTABILITIES OF OSCILLATING MARANGONI CONVECTION IN A LARGE CYLINDRICAL LIQUID COLUMN

The various types of liquid motion (convection) due to inhomogeneities of the interfacial tension in a free liquid surface are called Marangoni effects. The proposed experiment deals with investigations of higher oscillating modes of the Marangoni convection and their transitions into non-periodic states (turbulent convections) in a large liquid column as a function of the aspect ratio (height diameter) of the column and of the Marangoni numbers. This experiment will make use of the Advanced Fluid Physics Module.

•MARANGONI-BENARD INSTABILITY

The Marangoni-Benard instability will be studied in the steady state to measure the critical Marangoni number and to observe the inverse bifurcation behavior. The transient behavior will be studied to observe the effect of a nondistribution. Finally, by heating in the opposite direction, transverse capillary-gravity waves will be observed .

•ONSET OF OSCILLATORY MARANGONI FLOWS

The investigators intend to perform a systematic study of a series of cylindrical floating zones characterized by different values of the aspect ratio of disk diameter to determine the influence of sample geometry on oscillations onset and to determine the critical conditions and obtain a better understanding of the flow organization during oscillatory conditions.

•MARANGONI CONVECTION IN A RECTANGULAR CAVITY

There are various types of liquid motion (convection) due to inhomogeneities of the interfacial tension in free liquid surfaces which are called Marangoni effects. The experiment investigates one of the Marangoni effects, namely thermocappillary convection driven by temperature gradients applied parallel to the free liquid-gas surface. The experiment investigates the pure thermocappillary effect under microgravity to reduce the complexity of the highly non-linear coupled hydrodynamic system on Earth.

•STATIONARY INTERDIFFUSION IN A NON-ISOTHERMAL MOLTEN SALT MIXTURE

A new interdiffusion experiment on a molten salt mixture will be performed as the necessary continuation of the preceding D1 experiment. It is shown that the stationary state which was far from being obtained in D1, due to a smaller than predicted interdiffusion coefficient, should then be attained during a 24-hour duration experiment. In addition, the investigators intend to

evidence a variation of the interdiffusion coefficient with the mixture composition.

•TRANSPORT KINETICS AND STRUCTURE OF METALLIC MELTS:

Diffusion processes in melts are more or less disturbed under 1-g by convections which contribute to the atomic mixing process in a similar but irregular way. It is the goal of the D2 experiments to determine the temperature dependence of the diffusion coefficients for materials which are as much as possible different from Tin. Furthermore, there are different aspects to use the experimental opportunities of the D2 flight: continue self-diffusion experiments on other materials; continue inter-diffusion experiments with complex formation; determine inter-diffusion coefficients for the "Compound Project Monotectic Alloys" and complete measurements in the system started in D1.

•NUCLEATION AND PHASE SELECTION DURING SOLIDIFICATION OF UNDERCOOLED ALLOYS

Metallic melts of various alloys, embedded in a liquid matrix of boron-trioxide, will be cooled below their solidification temperature in their liquid state. Since under microgravity conditions, sedimentation is reduced by orders of magnitude, a contact of sample with crucible is avoided leading to the elimination of heterogeneous nucleation by wall contact. It is the goal of this experiment to determine the degree of undercooling for different alloy compositions by measuring the recalescence temperature and comparing with nucleation theory. In addition, the influence of undercooling on the grain size and phase selection will be investigated.

•HEATING AND REMELTING OF AN ALLOTROPIC FE-C-SI ALLOY IN A CERAMIC SKIN AND THE EFFECT OF THE VOLUME CHANGE ON THE MOLD'S STABILITY

The skin technology is to be tested with allotropic and non-allotropic materials for its suitability for remelting processes. For this purpose a melting sample with sections of Fe-C-Si alloys with different compositions will be remelted in a zirconia mold and solidified directionally. The interpretation will concentrate on the skin behavior, the crystallization of the graphite and the distribution of the elements in the transition zone.

•IMMISCIBLE LIQUID METAL SYSTEMS

NUCIM is an experiment investigating the behavior of two liquid immiscible metals in contact with different ceramic materials. In particular the Cu-Pb system with two different compositions will be investigated in contact with vitreous carbon, boron nitride and sapphire.

•CONVECTIVE EFFECTS ON THE GROWTH OF GAINSB CRYSTALS

This experiment will check the effects of convection on the chemical segregation of the components of highly concentrated terrary semiconductors. The purpose is to obtain homogeneous crystals, which is not possible on Earth.

•VAPOR GROWTH OF INP-CRYSTAL WITH HALOGEN TRANSPORT IN A CLOSED AMPOULE

It is well known that the mass transport phenomena are strongly affected by gravity. In the D2 mission, vapor growth of InP epitaxial layer with halogen transport in a closed ampoule is proposed to study the relation between the gravity and epitaxial layer quality.

•SOLUTION GROWTH OF GAAS CRYSTALS UNDER MICROGRAVITY

The solution growth experiment of GaAs crystals under microgravity planned aboard the D2 mission involves a technique that avoids the surface-tension-induced convection which destroys diffusion-controlled crystal growth, even under microgravity.

•CRYSTALLIZATION OF NUCLEIC ACIDS AND NUCLEIC ACID-PROTEIN COMPLEXES

The main purpose of this research project is to study the structure of ribosomal 5S RNAs, their protein complexes and the structure of the elongation factor EF-TU complex. The ribosomal 5S RNAs and their binding proteins are essential for the function of ribosomes, and their complexes also are considered to be good model systems for the study of RNA-protein complexes. The elongation factor EF-TU is required for protein synthesis. Since this protein forms in addition specific complexes with GTP and GDP, it also has been considered as a model system for the important class of regulatory G-proteins.

The objective is to explore all possibilities to crystallize these important biological molecules and their complexes to determine their three dimensional structure by x-ray analysis. The purpose of this project is to determine the influence of microgravity on the crystallization of these molecules during the D2 Spacelab mission.

•CRYSTALLIZATION OF RIBOSOMAL PARTICLES

The main goal of our project is to elucidate the model of the ribosome. The investigators are pursuing single crystal X-ray crystallographic studies and support them with information obtained from neutron diffraction and three-dimensional image reconstruction from electron-micrographs. The investigators believe that at microgravity more isotropic crystals can be grown.

HOLOGRAPHIC OPTICS LABORATORY (HOLOP)

The Holographic Optics Laboratory (HOLOP) is a multi-user experiment facility where fluid physics experiments are conducted under microgravity conditions. Located in rack 11, the aim of HOLOP is to investigate phenomena such as transient heat transfer, mass transfer, surface convections and particle motion in gatical transparent media through holographic methods. One of the four experiments is a test subject for studying the application of "telescience" techniques for preparation of utilization of space station missions.

•MARANGONI CONVECTION IN A RECTANGULAR CAVITY

There are various types of liquid motion (convection) due to inhomogeneities of the interfacial tension in free liquid surfaces which are called Marangoni effects. The MARCO experiment investigates one of the Marangoni effects, namely thermocapillary convection driven by temperature gradients applied parallel to the free liquid-gas surface. MARCO investigates the pure thermocapillary effect under microgravity to reduce the complexity of the highly non-linear coupled hydrodynamic system on Earth.

•INTERFEROMETRIC DETERMINATION OF THE DIFFERENTIAL INTERDIFFUSION COEFFICIENT OF BINARY MOLTEN SALTS

Interdiffusion coefficients are transport data that are difficult to measure. Under microgravity conditions, it is possible to exclude convection and to obtain exact reference values for the diffusion coefficients. The initial concentration step profile is generated with a flowing junction cell and the diffusion process is observed by means of holographic real time interferometry. The chosen system is Potassium Nitrate/Silver Nitrate at eutectic composition. The diffusion coefficient is going to be determined in dependence on temperature.

•IDILE: MEASUREMENTS OF DIFFUSION COEFFICIENTS IN AQUEOUS SOLUTION

IDILE is an experiment dedicated to measurements of diffusion coefficients through interferometric holography observation of refractive index changes due to evolution of concentration profiles as a function of time.

•NUGRO: PHASE SEPARATION IN LIQUID MIXTURES WITH MISCABILITY GAP

Phase separation of a demixing binary liquid mixture under 1-g conditions is observed by holographic image recording. A pressure jump technique is applied to induce the phase transition.

Radiation Detector (RD) is a set of four experiments in which different types of material and biological probes are exposed to different environmental conditions. The scientific products will be brought back for analyses to learn and develop techniques for radiation protection in space.

Baroreflex (BA)

The Baroreflex (BA) experiment is located in rack 12. This experiment will investigate the theory that lightheadedness and a reduction in blood pressures in astronauts upon standing after landing may arise because the normal reflex system regulating blood pressure behaves differently after having adapted to a microgravity environment.

In particular, the ability of the body's blood pressure sensors to control heart rate (the baroreceptor reflex) will be measured to see if the predicted impairment does indeed occur. Space-based measurements of the baroreflex will be compared to ground-based measurements to see if microgravity affects the reflex.

The tendency of a person to faint because of inadequate blood flow to the brain is called orthostatic hypotension. When standing on Earth, gravity tends to pull blood toward the feet and the baroflex acts to increase heart rate and blood pressure in the blood vessels, maintaining normal blood flow to the head. However, in microgravity the body does not have to make such cardiovascular adjustments to compensate for changes in body position.

In space, blood shifts naturally toward the head rather than the feet and the baroflex is not utilized during postural changes. Therefore, impairment or desensitization of normal baroreflex control of blood pressure may occur.

The purpose of this experiment is to determine if there are changes in the baroreflex in microgravity and if so, how they contribute to postflight orthostatic hypotension. Although orthostatic hypotension disappears within a few days after flight, it is very important to understand the causes of this condition which affects the health and safety of the astronauts, including the ability to land the Shuttle at the end of the mission.

The experiment uses the Baroreflex cuff, a silicone rubber cuff which seals around the neck when pressure is applied. The pressure system is controlled by a microprocessor. The crew member wears a rubber neck chamber and electrocardiograph (ECG) electrodes. Pulses of pressure and suction, which mimic natural blood pressure, are applied through the neck chamber and transmitted through the neck to baroreceptors. The heart rate change provoked by each pressure pulse is measured from the ECG. Heart rate changes will be measured before, during and after the spaceflight.

The Microgravity Measurement Assembly (MMA) is the core acceleration measurement system of D2. It consists of 6 tri-axial accelerometers, four of which are permanently mounted in experiment racks. Two packages can be placed at any suitable location within the Spacelab module.

•RESIDUAL ACCELERATION IN SPACELAB D2

The majority of investigations performed on D2 is intended to make use of the state of weightlessness which is virtually simulated in a freely drifting

spacecraft. Deviations of the spacecraft's dynamic state from ideal free fall conditions result in residual gravity-like accelerations. Despite orders of magnitude below 1-g, this microgravity condition can seriously affect the results of experiments. A detailed knowledge of the residual acceleration history, therefore, is mandatory for a thorough experiment analysis.

For the reason, Spacelab D2 is equipped with various measurement systems to detect the spatial and temporarily variation of the acceleration vector. There is, however, a lack of measurement data in the low-frequency range due to general sensor bias problems. Acceleration data in this regime will be estimated on the basis of a dynamic atmospheric model and the attitude data of the orbiter.

•TRANSFER FUNCTION EXPERIMENT

The proposed Transfer Function Experiment will cover the empirical and systematic investigation of the disturbance transmissibility characteristics and the transfer functions of the spacecraft structure under weightlessness. The microgravity transfer function describes the transmissibility behavior of a flexible spacecraft structure. It describes how a flexible structure will respond with vibrations/accelerations when excited at another location of the structure by a disturbance source. It will be extended by an impulse hammer enabling the measurement of inflight structural transfer functions.

The results of this experiment will substantiate and improve understanding of the on-orbit dynamic behavior of microgravity spacecraft structures. The evaluation of on-orbit transfer function measurements and comparison with on-ground test data and analytical predictions will improve the microgravity dynamics database and will directly support the preparation of further Spacelab missions and subsequent orbital microgravity spacecraft such as Eureca and Columbus.

Robotics Experiment (ROTEX)

ROTEX is a robotic arm that operates within an enclosed workcell in rack 6 of the Spacelab module and uses teleoperation from both an on-board work station located in rack 4 and the ground. This precise robotic arm uses teleprogramming and artificial intelligence to look at the design, verification and operation of advanced autonomous systems for use in future applications.

ROTEX is comprised of:

•A robot arm with six joints which can reach in all directions to grasp objects

•Two torque sensors located of the back of the gripper to ensure that the robot arm does not become overloaded

•A gripping assembly containing laser distance-measuring devices, tactile sensors and stereo television cameras which give a direct view of the object

•Two fixed video cameras that provide stereo pictures of the whole assembly.

For future spaceflight, it wiii be necessary to reduce the operational costs of space systems. In this context, the application of robotic systems will play a key role. The technology-transfer or spin-off back to terrestrial applications is expected to be larger than in many other areas and important in terms of political economics. Manipulators and robots will be used for assisting in and carrying out different tasks in space laboratories ("internal" use) and in free space ("external use"), in particular:

- exchange of orbit-replaceable units (ORU)
- handling of experiments and manufacturing processes
- assistance in rendezvous/docking
- repair
- supply and maintenance of free-flying platforms or geostationary satellites
- refuelling and "garbage collection"
- assembly of structures

The performance of diverse tasks by space manipulators requires a hierarchically and modularly structured automation concept tuneable to the special operational case, which in addition allows human interference on different levels of supervisory and decision control. This in term yields the requirements for the hardware and software concepts to be realized, covering the range from telemanipulation up to a completely autonomous operation. Independent of the different tasks and application scenarios, development of space robot technology tends to focus on the following topics:

- intelligent, sensor-controlled, light-weight manipulators
- modular gripper and tool systems for high versatility
- improved man-machine interfaces for teleoperation and supervisory control ("telerobotics" and "telescience") concepts
- stepwise increase of planning and decision autonomy by knowledge-based technology,
- cooperation and coordination of multi-arm and multi-robot system.

ANTHRORACK (AR)

The payload element "Anthrorack," developed for ESA, is designed to investigate human physiology under microgravity conditions. AR will provide a set of common user stimulation and measurement instruments, supported by centralized services including power supply, control and data handling. The AR is composed of the following service elements:

- Blood Sample Collection Kit
- Urine Monitoring System
- High Speed Centrifuge
- Respiratory Monitoring System
- Ergometer
- Peripheral Blood Measurement System
- Manual Blood Pressure Measurement System
- Limb Volume Measurement Device
- Electrode Contact Impedance Meter
- Ultrasound Monitoring System

AR components essentially are accommodated in a double rack. The ergometer is mounted to the experiment section of the lab's main floor.

•CARDIOVASCULAR REGULATION AT MICROGRAVITY

The mechanisms involved in the cardiovascular adaptation to microgravity will be examined during inflight studies of the responses to acute redistribution of body fluids. Intravenous saline loading is superimposed on the microgravity-induced fluid shifts. Supplementary pre- and post-flight procedures include quantitation of changes in myocardial and skeletal muscle mass by magnetic resonance imaging and characterization of adrenergic function by in-vivo and in-vitro experiments.

•THE CENTRAL VENOUS PRESSURE DURING MICROGRAVITY

The central venous pressure (CVP) is theorized to increase during weightlessness because of a central blood volume shift. Although CVP is an important physiological parameter, it never has been registered in humans during the launch conditions or long term weightlessness. Significant "microgravity" adaptation may occur while the astronauts are waiting on the launch pad in supine seated launched position. The aim of this experiment is to measure the CVP in two crewmembers during the supine seated position on the launch pad, the microgravity onset and the early adaptation through an arm vein.

•LEG FLUID DISTRIBUTION AT REST AND UNDER LBNP

Human adaptation to microgravity is a complex process involving multiple organ systems. Among these, the function and control of health and vessels are changed due to the lack of gravitational stress. First, body fluids shift towards the upper part of the body. Next, the body becomes dehydrated due to increased excretion and possibly, decreased fluid intake. As a result, the autonomic response patterns may be altered. Dehydration and disuse lead to volume reduction, especially in the lower limbs. Textural changes of the skin, musculature and vessels are anticipated to occur.

•DETERMINATION OF SEGMENTAL FLUID CONTENT AND PERFUSION

In weightlessness, the lack of hydrostatic pressure induces a large cephalad fluid shift that in turn causes a reduction in total body fluid. The hypothesis is that this results in a new body fluid distribution pattern. Different body segments are affected to different degrees. Additionally, reduced peripheral demands due to muscular underloading and a change in the activity pattern of the cardiovascular autonomic control system contribute to induce a process of cardiovascular adaptation.

•LEFT VENTRICULAR FUNCTION AT REST AND UNDER STIMULATION

This experiment intends to get insight into the mechanisms underlying cardiovascular adaptation to weightlessness. The experiment emphasizes the role played by the heart in the process of adaptation to weightlessness and readaptation to Earth's gravity.

•PERIPHERAL AND CENTRAL HEMODYNAMIC ADAPTATION TO MICROGRAVITY DURING REST EXERCISE AND LOWER BODY NEGATIVE PRESSURE IN HUMANS

This experiment will investigate the cardiovascular reflexes during weightlessness in man by applying standard stimuli to the body and record the induced changes. Cardiovascular parameters to be measured include Echo Cardiograph (ECG), cardiac output (rebreathing method), arterial blood pressures during rest and during isometric exercise (sustained handgrip exercise) and dynamic exercise (bicycle exercise on a specially constructed mechanically breaked ergometer).

However, during this experiment the subcutaneous blood flow on the forearm will be studied. This way it will be possible to calculate the changes in both total periperal resistance as well as forearm vascular resistance as an expression of cardiovascular regulation. The experiments will be performed preflight and inflight.

•TONOMETRY - INTRAOCULAR PRESSURE IN MICROGRAVITY

Microgravity leads to an increase in intraocular pressure due to a fluid shift from the lower to the upper part of the body. Up to now little was known about the peak values and the adaptation process. The greatest alteration in intraocular pressure is expected during the early phase after launch. Because the astronauts are fastened in during this phase, measurements have not been performed. To solve this problem and to save crew time, a tonometer was developed which enables self tonometry. Initial measurements during so-called "parabolic flights" could demonstrate the practical use of the new equipment under micrgogravity conditions without any problem.

•THE CENTRAL VENOUS PRESSURE DURING MICROGRAVITY

The central venous pressure (CVP) is theorized to increase during weightlessness because of a central blood volume shift. Although CVP is an important physiological parameter, it never has been registered in humans during the launch conditions or long term weightlessness. Significant microgravity adaptation may occur while the astronauts are waiting on the launch pad in supine seated launch position. The purpose of this experiment is to measure the CVP in two crew members during the supine seated position on the launch pad, the microgravity onset and the early adaptation to weightlessness by means of a thin catheter introduced through an arm vein.

•TISSUE THICKNESS AND TISSUE COMPLIANCE ALONG BODY AXIS UNDER MICRO-G CONDITIONS

A new method will be introduced to quantify fluid shifts within superficial tissues along the body axis of a human subject. Furthermore, the distensibility of these tissues will be measured. The methods will be applied under micro-g conditions, to answer basic questions of the salt-water balance of humans under extreme conditions.

•CHANGES IN THE RATE OF WHOLE-BODY NITROGEN TURNOVER, PROTEIN SYNTHESIS AND PROTEIN BREAKDOWN UNDER CONDITIONS OF MICROGRAVITY

Under conditions of microgravity, there is a fluid shift away from the peripheral muscles of the lower limbs towards the viscera of the gut and splanchnic regions of the body. This is accompanied by a negative fluid and nitrogen balance, the latter of which results in a reduction of muscle tone, muscle fatigue and muscle atrophy. The purpose of the present study is to measure the rates of whole-body nitrogen turnover (flux), protein synthesis and protein breakdown in 3 astronauts before, during and after the D2 mission to identify the mechanism(s) responsible for the negative nitrogen balance.

•REGULATION OF VOLUME HOMEOSTASIS IN REDUCED GRAVITY POSSIBLE INVOLVEMENT OF ATRIAL NATRIURETIC FACTOR URODILATIN AND CYCLIC GMP

The objective of this investigation is to study the involvement of hormonal systems in the readaptation of humans to weightlessness. In detail, possible alterations in the plasma levels and urinary excretion rates of atrial natriuretic factor, of urodilatin and of cyclic GMP will be studied. These factors are important hormones and parameters regulating volume homeostasis which is known to be markedly altered in weightlessness. Thus, the current investigation is aimed at gaining a better understanding of volume homeostasis under microgravity conditions.

•EFFECTS OF MICROGRAVITY ON GLUCOSE TOLERANCE

Based on results from simulation experiments on the ground, it is hypothesized that an abnormal glucose/insulin relation and an impaired glucose tolerance occurs in spaceflight. The metabolic imbalance may increase with progressive exposure. It is anticipated that the results of the study in space will have significance for both the assessment of metabolic responses to weightlessness and for clinical medicine on Earth.

•THE INFLUENCE OF MICROGRAVITY ON ENDOCRINE AND RENAL ELEMENTS OF VOLUME HOMEOSTASIS

It is hypothesized that the renal excretion of electrolytes and water in humans increase upon entering the microgravity environment and that a new state of adaptation is reached in regard to volume homeostatic mechanisms. Therefore, the purpose is to investigate the lack of hydrostaticendocrine and renal elements of volume homeostasis in human test subjects.

•EFFECTS OF SPACEFLIGHT ON PITUITARY-GONAD-ADRENAL FUNCTION IN THE HUMAN

Spaceflight conditions are very strong, stressful stimuli and are expected to have some impact on individual working capacity. A very important topic, on the other hand, is the circadian rhythmicity of hormonal secretion. Such regular rhythms might be disrupted by incorrect time shift schedules. The aim of this study is to check blood, urine and saliva to detect any signs of adrenal/reproductive glands disturbance occurring in microgravity to better design working/resting rhythms during next flights. It is in fact of enormous relevance to human species survival and to subject's space work motivation that the hormonal milieu, somehow responsible for subject's well-being and working capacity as well as for reproductive and sexual equilibrium, keep within normal ranges in microgravity conditions.

•ADAPTATION TO MICRO-G AND READAPTATION TO TERRESTRIAL CONDITIONS

In this experiment, the observation of the Renin-Angiotensin-Aidosterone System, which is one of the main factors in the regulation of salt-balance and blood pressure, will be made.

•PULMONARY STRATIFICATION AND COMPARTMENT ANALYSI WITH REFERENCE TO MICROGRAVITY

The in-orbit elimination of the gravity vector provides an unique opportunity to study the effect of gravity on the distribution of ventilation in the human lung. The primary scientific objective of this experiment is to test, whether entry into orbit will alleviate the inhomogeneity in the distribution of the ventilation-volume ratio, as measured by a multiple breath gas wash-in/wash-out test.

•PULMONARY PERFUSION AND VENTILATION IN MICROGRAVITY REST AND EXERCISE

Gravity is considered to be the most important factor influencing the distribution of both ventilation and blood perfusion in the lung. According to current hypotheses, both these processes take place mainly in the lower part of the lungs. However, the degree of unevenness is different between ventilation and perfusion, so that upper parts (with respect to the G vector) are relatively over-ventilated with respect to perfusion and lower parts are relatively over perfused with respect to ventilation.

The concept described has a major impact on present scientific and clinical understanding of the pulmonary function. The concept, however, is hypothetical and remains to be proven by direct experimental evidence. The proposed experiments include methods and procedures for such studies.

•VENTILATION DISTRIBUTION IN MICROGRAVITY

Under normal gravity conditions on Earth, the lower part of the lung ventilates almost twice as much as the upper part of the lung. The major scientific objective of this experiment, carried out in the Anthrorack facility, is to understand the role of gravity in determining the pattern of ventilation in the lungs and the components involved in ventilation.

This will be accomplished by studying the influence of microgravity on lung ventilation, lung blood flow, capillary volume, the lung's liquid content and changes in the breathing pattern.

In a parabolic aircraft flight, an experiment was conducted to look at some of these changes. Data from this experiment showed a much more even pattern of ventilation in the lung than expected when in microgravity. It also was observed that the lung volume decreases significantly and the pattern of breathing is changed.

The flight of this experiment aboard the Spacelab D2 mission will help to define the effects of microgravity on the lung. This experiment will use experiment specific equipment called the "Respitrace."

•EFFECTS OF MICROGRAVITY ON THE DYNAMICS OF GAS EXCHANGE, VENTILATION AND HEART RATE IN SUBMAXIMAL DYNAMIC EXERCISE

Before, during and after the D2 mission, pseudo-randomized power changes between 20 w and 80 w of cycle ergometer exercise will be applied as stimulus to study the kinetics of oxygen consumption, C02-output, ventilation, blood pressure and heart rate. A major intention is to find out whether the determination of C02 kinetics qualifies as a method for monitoring endurance performance during space flight.

•CARDIOVASCULAR REGULATION IN MICROGRAVITY

The objective of this experiment is to study the cardiovascular effects of microgravity on subjects at rest and during exercise.

This study, performed in the Anthrorack facility, will study the multiple mechanisms believed to be responsible for rapid and effective adaptation to microgravity as well as the cardiovascular dysfunction that is observed on return to Earth. An additional objective is to validate 24-hour, 5-degree head-down bedrest as a model for studies of acute cardiovascular response to weightlessness.

This experiment uses specific equipment called the Doppler flow device along with the Blood Pressure Measurement System.

Based on current evidence, upon entering microgravity, astronauts experience a dramatic fluid shift from the lower into the upper part of the body. This occurs primarily because of the loss of all hydrostatic gradients; the compressive force of the muscles and blood vessels in the legs and dependent abdominal areas is therefore unopposed by gravity and propels fluid headward. As a result of this fluid shift, central blood volume and cardiac pressures increase, simulating an expansion of the intravascular volume and setting in motion a cascade of volume-regulating mechanisms.

The end result of this process is a reduction of fluids in the lower part of the body and a loss of the excess fluid in the upper part of the body that had shifted headward. Significant net losses of body fluid therefore are experienced by crewmembers in space during the first few days in microgravity and in the ensuing week or so, other elements of the cardiovascular system change to accomodate the loss of fluid and gravity stimulus.

The objectives of this experiment are to study the multiple mechanisms believed to be responsible for the adverse responses in astronauts upon landing, including hypovolemia, altered neurohumoral control mechanism and structural changes affecting the cardiovascular system and to examine interactions between these mechanisms. Understanding these processes suggest methods for countering their unwanted effects.

Two different in-flight procedures will be performed: rapid intravenous saline loading and lower body negative pressure. Both procedures are based on collaboration among several groups of D2 investigators and both will produce detailed data on cardiovascular and neurohumoral responses.

BIOLABOR (BB)

The Biolabor will be used to perform research in electrofusion of cells, cell cultivation, botany experiments and zoological experiments. The Biolabor facility is a life sciences and biotechnology research device developed by Germany (MBB/Erno) for use in the Shuttle/Spacelab. Biolabor consists of a cell electrofusion workbench equipped with a microscope, a cell electrofusion

control unit, two cell cultivation incubators, a 41 C cooler and two middeck-mounted cooling boxes.

The workbench can accommodate a series of experiment-specific test chambers, including chambers to support electrofusion of different protoplasts of plant species and chambers for electrofusion of mammal cells. The workbench microscope allows observation of the test chambers by the crew and the experimenter via downlinked video. Biolabor experiments include:

•DEVELOPMENT OF VESTIBULOCULAR REFLEXES IN AMPHIBIA AND FISHES WITH MICROGRAVITY EXPERIENCE

This experiment will examine whether the functional development of the vestibular system of lower vertebrates is affected by a short lasting stay under micro-g conditions during very early periods of life. Vestibulocular reflexes are a useful tool to determine efficiency changes of the developing vestibular system. After the spaceflight, the extent of these reflexes will be determined for each of the very delicate animals throughout its life until metamorphosis. For this purpose, a closed living system will be constructed which also allows the recording of the reflexes without changing the environment.

•COMPARATIVE INVESTIGATIONS OF MICROGRAVITY EFFECTS ON STRUCTURAL DEVELOPMENT AND FUNCTION OF THE GRAVITY PERCEIVING ORGAN OF TWO WATER LIVING VERTEBRATES

This contribution is a survey of the DLR-part of the space experiment "The Observation of Gravity and Neuronal Plasticit" or STATEX II. The main points are the morphological differentiation of the vestibular organs and their subunits in weightlessness and an analysis of the loop swimming behavior following gravity variations. For the first time, the development of two different aquatic vertebrates, exposed to identical experimental conditions in space, can be compared.

•STRUCTURE- AND FUNCTION-RELATED NEURONAL PLASTICITY OF THE CNS OF AQUATIC VERTEBRATES DURING EARLY ONTOGENETIC DEVELOPMENT UNDER MICROGRAVITY-CONDITIONS

On the basis of behavioral studies, the influence of about 9 days of near weightlessness during early ontogenetic development of larvae of a type of colored perch fish and tadpoles of the South American clawed frog will be investigated by means of light and electronmicroscopical techniques and biochemical analyses especially with regard to the differentiation of gravity-related integration centers in the central nervous system.

•IMMUNOELECTRON MICROSCOPIC INVESTIGATION OF CEREBELLAR DEVELOPMENT AT MICROGRAVITY

By means of immunoelectron microscopical the influence of weightlessness on structural and functional parameters of the cerebellum of

cichlid fish and clawed toad larvae will be investigated using poly- and monoclonal antibodies against specific cell adhesion molecules.

•GRAVISENSITIVITY OF CRESS ROOTS

Gravity sensing systems in plants are characterized by three intracellular components:

- sedimenting particles functioning as statoliths
- the ground cytoplasm as surrounding medium and
- membranes (probably inner membranes) functioning as signal transducers.

The experiment gravisensing will determine threshold value, the minimum dose for cress roots cultivated on a 1g centrifuge and under reduced gravity, respectively, using a threshold value centrifuge. In a second approach, the fine structural characteristic of the gravity perceiving cells (statocytes) is correlated with this threshold value by preparation of the seedlings in orbit for electron microscopy on ground. Finally the summation of subminimal doses is proven and again correlated with the fine structure of statocytes to obtain first information on a "memory" of plants for the stimulus gravity.

•CELL POLARITY AND GRAVITY

The microgravity experiments described below shall elucidate the question as to whether gravity is a polarizing factor in higher plant cells and if so, what its rank is among other polarizing factors.

•INFLUENCE OF GRAVITY ON FRUITING BODY DEVELOPMENT OF FUNGI

The D2 mission provides an excellent opportunity for obtaining information on the ultrastructure of fruiting bodies grown under micro- and 1-gravity conditions. These results are expected to improve knowledge about the mechanisms of graviperception and the influences of weightlessness on fungal morphogenesis.

•SIGNIFICANCE OF GRAVITY AND CALCIUM-IONS ON THE PRODUCTION OF SECONDARY METABOLITES IN CELL SUSPENSIONS

The influence of gravity and calcium metabolism on metabolite production, growth and regeneration capacity of cell cultures will be investigated. Simulation experiments, using a clinostat and a centrifuge specifically adapted to cell cultures, will be conducted on Earth. In addition, experiments with calcium chelators, calcium ionophores and calmodulin antagonists are planned.

In this experiment, for the first time in manned space flight, fluid cultures beside solid cultures will be exposed to microgravity and cosmic radiation. The aim of the experiment is to improve properties of the yeast by

durable fixed genetic mutations. The genome of the HB-L29 yeast, used in the experiment, shows two additional chromosomes in comparison to cultures investigated up to now.

•INFLUENCE OF CONDITIONS IN LOW EARTH ORBIT ON EXPRESSION AND STABILITY OF GENETIC INFORMATION IN BACTERIA
•PRODUCTIVITY OF BACTERIA
•FLUCTUATION TEST ON BACTERIAL CULTURES

Unexpectedly, bacteria, when growing in low Earth orbit, have shown differences in growth rate and amount of final biomass produced as compared to their counterparts on Earth. These earlier studies will be continued to include measurements of the yield of specific products, of the stability of genetic information and of the re-adaptation to growth at 1-g.

•CONNECTIVE TISSUE BIOSYNTHESIS IN SPACE: GRAVITY EFFECTS ON COLLAGEN SYNTHESIS AND CELL PROLIFERATION OF CULTURED MESENCHYMAL CELLS

Astronauts, experiencing long periods of space flight, suffer from severe degeneration of bones. As it seems, lack of mechanical load decreases connective tissue biosynthesis in bone forming cells. To test this assumption cultured mesenchymal cells, which actively produce connective tissue proteins, will be kept under microgravity during the D2 mission. Composition, relative amount and structure of synthesized proteins, which consist mainly of collagen, will be characterized. The same will be done with control cultures incubated at normal gravity and hypergravity.

•ANTIGEN-SPECIFIC ACTIVATION OF REGULATORY T-LYMPHOCYTES TO LYMPHOKINE PRODUCTION
•GROWTH OF LYMPHOCYTES UNDER MICRO-G CONDITIONS

An experimental 1-g test system was devised involving the foreign antigen-driven stimulation of regulatory T cells by antigen-presenting accessory cells. Under conditions of weightlessness, undisturbed antigen-mediated cluster formation between responsive T cells can be expected which is anticipated to lead to elevated levels of secreted lymphokines. The amount of representative lymphokines produced under micro-g and 1-g conditions will be determined. These measurements might provide new insights into the interactive relationship between T cells and accessory cells.

•ENHANCED HYBRIDOMA PRODUCTION UNDER MICROGRAVITY

During the Spacelab D2 mission, the United States and Germany will carry out collaborative studies to evaluate whether the microgravity environment can be used to produce cells with useful properties.

Specifically, the experiments will examine the process of cell electrofusion, where electric currents are used to join cells with different characteristics to produce hybrids. These experiments will examine the fusion

of human blood cells, called lymphocytes, with tumor cells. The resulting fusion products, hybridoma, may produce proteins that can be used to kill cancerous cells.

Previous experiments on sounding rockets have shown an increase in the efficiency in hybridoma production in microgravity. The joint U.S./German experiments will probe the possible causes of this increase.

As their contribution to the research, the German Space Agency developed the Biolabor, a multi-user cell fusion device. The U.S. science team will provide the cell samples and will carry out the post-flight analysis. In addition to the hybridoma experiments, Biolabor also will be used to carry out plant cell fusion experiments.

This experiment will attempt to determine the extent to which the microgravity environment will enhance the generation of hybrid cells produced by electrofusion. Dr. David W. Sammons, University of Arizona, Tucson, and his German collaborators will attempt to fuse B lymphocytes P white blood cells that produce antibodies that circulate in the blood stream P with cells from myeloma P tumors that afflict bone marrow. The science team hopes to produce hybridoma that efficiently produce highly specific antibodies.

Experiments carried out in the European Texus sounding rocket program have demonstrated that performing cell electrofusion in microgravity increases the number of fusion events as well as the number of recoverable, viable cell hybrids. During the D2 mission, crew members will use the Biolabor hardware to carry out experiments to reveal the causes for the increase in the efficiency of cell electrofusion during the sounding rocket flights.

Several days prior to the launch of the Spacelab D2 mission, the U.S. science team will begin preparing Myeloma and B lymphocyte cells. The various cell types will be loaded in flexible, gas-permeable flasks, which will be stored in incubator boxes in the Shuttle middeck 12 hours before launch.

On orbit, the cells will be transferred to incubators in the Biolabor facility in the Spacelab module. During the third mission day, lymphocytes and myeloma cells will be centrifuged and combined in the fusion chambers. Electric pulses of varying lengths will be applied to the different samples. Following cell-electrofusion, some of the sample sets will be "fixed" for later study. Others will be incubated for the remainder of the mission. Ground control experiments will be carried out in parallel with the flight experiments in a laboratory at the NASA Kennedy Space Center.

- CULTURE AND ELECTROFUSION OF PLANT CELL PROTOPLASTS UNDER MICROGRAVITY: MORPHOLOGICAL/BIOCHEMICAL CHARACTERIZATION

Plant cell protoplasts of different origin (leaf tissue, cell cultures) and fusion products, formed therefrom by electrical cell fusion techniques, will be cultured for about 10 days under 1-g conditions and compared to identical

samples kept under 1-g both in orbit (1-g reference centrifuge) and on the ground. To monitor possible morphological and physiological/metabolical deviations occurring under 1-g, sample specimen are taken and metabolically quenched in defined time intervals. The analytical part will cover microscopy, determination of cellular pool sizes of intermediates of energy and carbohydrate metabolism and protein analysis.

•YEAST EXPERIMENT HB-L29/YEAST: INVESTIGATIONS ON METABOLISM

In this experiment, for the first time in manned space flight, fluid cultures (Saccharomyces uvarum var. carlsbergensis) beside solid cultures will be exposed to microgravity and cosmic radiation. The purpose of the experiment is to improve properties of the yeast by durable fixed genetic mutations. The genome of the HB-L29 yeast used in the experiment shows two additional chromosomes in comparison to cultures investigated up to now.

COSMIC RADIATION EXPERIMENTS

On the D2 mission, detectors will be worn by the astronauts and placed near the biological experiments as control indicators. They also will be placed in the biostacks, which are stacks of trays containing small biological specimens such as plant seeds, insect eggs and bacterial spores, alternating with radiation detectors. The results of these experiments will contribute to the assessment of the biological effects of specific cosmic radiation and so help to reduce the health risks for future human exploration missions.

•BIOLOGICAL HZE-PARTICLE DOSIMETRY WITH BIOSTACK

This experiment is part of a radiobiological space research program including experiments in space as well as at accelerators on Earth. The program has been specially designed to increase knowledge on the importance, effectiveness and hazards to humans and to any biological specimen in space of the particles of high atomic number and high energy of the cosmic radiation. Its unknown proper biological effectiveness may significantly affect the design of the space station and its operation. Findings of earlier Biostack experiments clearly indicate the significance of high energy particles. More detailed information is necessary and requires more investigations in this matter.

•PERSONAL DOSIMETRY: MEASUREMENT OF THE ASTRONAUT'S IONIZING RADIATION EXPOSURE

Personal dosimetry of the astronauts' ionizing radiation exposure is an indispensable part of the biomedical surveillance in human spaceflight. The different components of the cosmic radiation field are to be measured with different, passive and tissue equivalent, radiation detectors, each specialized for the registration of, respectively, the heavy ions, the nuclear disintegration stars, and the sparsely ionizing background radiation, i.e., the electrons, protons and rays. Small stacks of these detectors are to be attached to the

astronauts' bodies in the vicinity of potentially critical organs to establish a permanent record of the astronauts' exposure to the cosmic radiation field.

•MEASUREMENT OF THE RADIATION ENVIRONMENT INSIDE SPACELAB AT LOCATIONS WHICH DIFFER IN SHIELDING AGAINST COSMIC RADIATION

The experiment has the objective to document the radiation environment inside the Spacelab and to compare the experimental data with theoretical predictions. This will provide radiation baseline data required for the flight personnel and any radiation sensitive experiment and material. These data are necessary for establishing radiation protection guidelines and standards for the presence of people in space. For this purpose, containers with different kinds of radiation detectors will be placed in locations which differ in shielding against cosmic radiation. The analysis of the dosimeters will be performed after flight in the laboratories of the investigators.

•CHROMOSOME ABERRATION

Chromosomal aberrations, micronuclei and sister-chromated exchanges will be analyzed in the peripheral lymphocytes of astronauts. The analysis will be performed shortly before and after the space flight and 4 weeks, 6 months and 1 year after the flight. The data obtained will be used as a biological dosimeter for the exposure of astronauts to ionizing radiation during the space flight.

•BIOLOGICAL RESPONSE TO EXTRATERRESTRIAL SOLAR UV RADIATION AND SPACE VACUUM

The photobiological and photobiochemical response to solar UV radiation in space will be studied in spores of Bacillus subtilis and in DNA isolated from Hemophilus influenzas. For that purpose, 2 exposure trays, accommodating the biological samples for exposure to space vacuum and/or to selected intensities and wavelengths of extraterrestrial solar UV radiation, will be mounted onto the User Support Structure.

USER SUPPORT STRUCTURE (USS) PAYLOADS

A structure mounted in the Columbia's cargo bay near the module provides support for additional experiment facilities which can be connected to the module for power and data, but which may run independently.

The **Material Science Autonomous Payload (MAUS)** is comprised of two experiments: one explores diffusion phenomena of gas bubbles in salt melts, while the other performs research of complex boiling processes.

•POOL BOILING

Nucleate pool boiling in theory is strongly gravity dependent. The MAUS experiment with its good zero-g quality should confirm results of KC- 135 parabolic flight missions that pool boiling is quasi gravity independent.

•GAS BUBBLES IN GLASS MELTS

The shrinking of a single oxygen bubble in a cylindrical sample is observed to determine the diffusion coefficient in a soda-lime-silica melt. A camera takes pictures of the bubble in certain time intervals. The diffusion coefficient can be calculated from this radius-time dependence by means of a finite differences method.

•REACTION KINETICS IN GLASS MELTS

Goal of these experiments is the determination of diffusion coefficients in order to verify mathematical models describing mass transport in glass melts. Two types of experiments will be conducted: interdiffusion between glass melts of the system and corrosion of silica glass by alkali silicate melts. Sixteen individual samples in four separate furnaces will be processed at temperatures of 1470 K and 1520 K for 20 or 40 minutes of annealing time.

The **Atomic Oxygen Exposure Tray (AOET)** is a self-standing facility located on the support structure that performs experiments in the field of material science. The AOET uses the orbiter as an exposure laboratory to obtain inside reaction rate measurements for various materials interacting with atomic rate measurements for various materials interaction with atomic oxygen with the low-Earth orbital environment.

AOET is dedicated to investigate the erosion effects on a technological basis. Erosion is supposed to be a vital problem for the realization of future space vehicles like Columbus, the European segment of the U.S. Space Station Freedom. The lifetime of its structural materials is defined to 30 years. Prime candidates are fiber reenforced materials which have to be protected against erosion.

The AOET is a quasi passive sample array mounted onto the Unique Support Structure within the cargo bay such that the samples are facing the incoming atmospheric flow. The 124 sample plates are either circular or rectangular sized, depending on post mission analysis needs.

The **Galactic Ultrawide-Angle Schmidt System Camera (GAUSS)** is an ultraviolet camera used to provide wide-angle, photographic coverage of the galaxy. Pictures taken of the Milky Way galaxy, younger stars and the gas clouds, which they warm up, will extend the knowledge of our galaxy significantly. A number of exposure of the Earth's atmosphere also are planned when the orbiter bay faces the Earth. The GAUSS camera is a mirror system for the ultraviolet with a field of view of 145 degrees. About 100 exposures of the Milky Way and the upper atmosphere shall be taken

The **Modular Optoelectronic Multispectral Stereo Scanner (MOMS)** is an advanced camera system for Earth observation. The instrument is located on the USS platform and provides imaging data from space for photogrammetric mapping and thematic mapping applications. It is an improved instrument based on MOMS-01 that was flown in 1983 and 1984.

MOMS-02 improves existing Earth observations with its long-track, high-performance stereo capabilities and digital images of higher geometric resolution and accuracy. Through the high geometric resolution and geometric accuracy of the threefold stereo module, it is possible to derive digital terrain models with a precision of better than 5 m. The optimized multispectral module aims at improved thematic information. New understandings in applications such as cartography, landuse, ecology and geology are expected.

CREW TELESUPPORT EXPERIMENT (CTE)

This experiment combines an onboard computer-based, multi-media documentation file, including text, graphics and photos, with a real-time, graphical communication between the on-orbit crewmember and the ground station. The result of CTE will enhance the effectiveness of the following areas:

- On-orbit payload operations
- Scientific return
- Crew to ground interaction
- Contingency maintenance tasks for systems and payloads

Equipment used for the CTE is the interactive Hypermedia documentation file stored on an optical disk and a Macintosh portable computer equipped with a pen-activated, interactive graphics tablet as a peripheral.

SHUTTLE AMATEUR RADIO EXPERIMENT (SAREX)

Students in the United States and around the world will have a chance to speak via amateur radio with astronauts aboard the Space Shuttle Columbia during STS-55. There also will be voice contacts with the general ham community as time permits. Also during the mission, an antenna test will be conducted on orbits 61 and 62 involving many amateur radio stations in the southern U.S. who will measure the exact time of acquistion of signal and loss of signal along with other data.

Shuttle Commander Steve Nagel (call sign N5RAW), Pilot Jerry Ross (N5SCW) and payload specialists Hans Schlegel (DG1KIH) and Ulrich Walter (DG1KIM) will talk with students in nine schools in the United States and with students in France, Australia and South Africa using "ham radio."

Students in the following U.S. schools will have the opportunity to talk directly with orbiting astronauts for approximately 4 to 8 minutes:

* Meadow Village Elementary, San Antonio, Texas (WA5FRF)
* Fairmont Elementary, Deer Park, Texas (N5NBM)
* John S. Ward Elementary, Houston (N5EOS)
* Cumberland Junior High, Sunnyvale, Calif. (WZ6N)
* Mudge Elementary, Fort Knox, Ky. (KE4NS)
* Seven Mills and Lotspeich Elementary, Cincinnati (KF8YA)
* St. Martin's Episcopal, Metairie, La. (N4MDC)
* Trumansburg Middle, Trumansburg, N.Y. (N2PNA)
* U.S. Air Force Academy, Colo. (K0MIC)

The international schools that will communicate with the crew are:

* Westering High School, Port Elizabeth, South Africa
* Sisekelo High School, Swaziland, South Africa
* Tamworth High School, New South Wales, Australia
* Gladstone State High School, Gladstone, Queensland, Australia
* French Air Force Academy, Salon de Prov, France

The astronaut/student radio contact is part of the SAREX project, a joint effort by NASA, the American Radio Relay League (ARRL) and the Amateur Radio Satellite Corporation (AMSAT).

The project, which has flown on seven Shuttle missions, was designed to encourage public participation in the space program and support the conduct of educational initiatives through a program to demonstrate the effectiveness of communications between the Shuttle and low-cost ground stations using amateur radio voice and digital techniques.

SAREX is a secondary payload located in Columbia's crew cabin. Another amateur radio experiment, called SAFEX, will be aboard the Spacelab D2 module and will be operated by licensed German payload specialists. SAFEX uses an external dual band 2 meter/70 cm antenna mounted on the ourside of the Spacelab while SAREX uses a window-mounted antenna in the Shuttle's cockpit.

Information about orbital elements, contact times, frequencies and crew operating schedules will be available during the mission from NASA, ARRL and AMSAT.

The ham radio club at the Johnson Space Center (W5RRR) will be operating on amateur short wave frequencies, and the ARRL station (W1AW) will include SAREX information in its regular voice and teletype bulletins.

There will be a SAREX information desk during the mission in the JSC newsroom. Mission information will be available on the computer bulletin board (BBS). To reach the bulletin board, use JSC BBS (8 N 1 1200 baud), dial 7713-483-2500, then type 62511.

The amateur radio station at the Goddard Space Flight Center (WA3NAN) will operate around the clock during the mission, providing information and retransmitting live Shuttle air-to-ground audio.

STS-55 SAREX Frequencies

Routine SAREX transmissions from the Space Shuttle may be monitored on 145.55 MHz for downlink. This 600 KHz spacing in the transmit/receive frequency pair is compatible with amateur VHF equipment.

Voice Uplink Frequency	144.91 MHz
	144.93
	144.95
	144.97
	144.99
Packet downlink frequency	144.55 MHz
Packet uplink frequency	144.49

The Goddard Space Flight Center amateur radio club planned HF operating frequencies:

3.860 MHz	7.185 MHz
14.295	21.395
28.395	

STS-55 CREW BIOGRAPHIES

Steven R. Nagel, 47, Col., USAF, will command STS-55. Selected as an astronaut in 1979, Nagel's hometown is Canton, Ill. He will be making his fourth space flight.

Nagel graduated from Canton Senior High School in 1964, received a bachelor's degree in aeronautical and astronautical engineering from the University of Illinois in 1969 and received a master's degree in mechanical engineering from California State University in 1978.

He first flew as a mission specialist on STS-51G in June 1985, a flight that deployed three commercial communications satellites. His next flight was as Pilot on STS-61A in November 1985, the first West German-United States cooperative Spacelab mission. His third flight was as Commander of STS-37 in April 1991, a mission that deployed NASA's Gamma Ray Observatory. Nagel has logged 483 hours in space.

Terence T. "Tom" Henricks, 41, Col., USAF, will be Pilot of STS-55. Selected as an astronaut in June 1985, Henricks considers Woodville, Ohio, his hometown and will be making his second space flight.

Henricks graduated from Woodmore High School in 1970, received a bachelor's degree in civil engineering from the Air Force Academy in 1974 and received a master's degree in public administration from Golden Gate University in 1982.

Henricks graduated from the Air Force Test Pilot School in 1983 and was serving as an F-16C test pilot at the time of his selection by NASA. He has logged more than 3,600 hours of flying time in 30 different types of aircraft and holds a master parachutist rating with 747 jumps to his credit.

His first space flight was as Pilot of STS-44 in November 1991, a Department of Defense-dedicated Shuttle flight that deployed the Defense Support Program satellite. He has logged more than 166 hours in space.

Jerry L. Ross, 45, Col., USAF, will be Mission Specialist 1 (MS1). Selected as an astronaut in May 1980, Ross' hometown is Crown Point, IN, and he will be making his fourth space flight.

Ross graduated from Crown Point High School in 1966, received a bachelor's degree in mechanical engineering from Purdue University in 1970 and received a master's degree in mechanical engineering from Purdue in 1972.

Ross' first flight was as a mission specialist on STS-61B in November 1985, a mission that deployed three commercial communications satellites and on which Ross performed two spacewalks to test space station construction methods. His next flight was STS-27 in December 1988, a classified Department of Defense-dedicated mission.

His third flight was on STS-37 in April 1991, a mission that deployed NASA's Gamma Ray Observatory and on which Ross performed two spacewalks, one to unstick a balky antenna on the satellite and another to evaluate space station hardware. Ross has logged 414 hours in space and 23 hours of spacewalk time.

Charles J. Precourt, 37, Major, USAF, will be Mission Specialist 2 (MS2) on STS-55. Selected as an astronaut in January 1990, Precourt considers Hudson, Mass., his hometown and will be making his first space flight.

Precourt graduated from Hudson High School in 1973, received a bachelor's degree in aeronautical engineering from the Air Force Academy in 1977, received a master's degree in engineering management from Golden Gate University in 1988 and received a master's in national security affairs and strategic studies from the Naval War College in 1990.

Precourt graduated from the Air Force Test Pilot School in 1985 and served as a test pilot in the F-15E, F-4, A-7 and A-37 aircraft. He was selected as an astronaut after graduating from the Naval War College and has logged more than 4,300 hours of flying time in 35 different types of aircraft.

Bernard A. Harris, Jr., 36, M.D., will be Mission Specialist 3 (MS3). Selected as an astronaut in January 1990, Harris was born in Temple, Texas, and will be making his first space flight.

Harris graduated from Sam Houston High School in San Antonio in 1974, received a bachelor's degree in biology from the University of Houston in 1978 and received a doctorate of medicine from Texas Tech School on Medicine in 1982.

Harris completed a residency in internal medicine at the Mayo Clinic in 1985, completed a National Research Council Fellowship at NASA's Ames Research Center in 1987 and trained as a flight surgeon at the Aerospace School of Medicine at Brooks Air Force Base in San Antonio in 1988.

Harris joined NASA in 1987, serving as a clinical surgeon and flight surgeon at the Johnson Space Center until his selection as an astronaut.

Ulrich Walter, 38, will be Payload Specialist 1 (PS1). Nominated as a German astronaut by the German space agency in 1987, Walter was born in Iserlohn, Germany, and will be making his first space flight.

Walter graduated from Iserlohn's Markisches Gymnasium in 1972, graduated with a degree in physics from the University at Cologne in 1980 and received a doctorate in solid state physics from the University of Cologne in 1985. He performed post-doctoral work at the Argonne National Laboratory in Chicago in 1986 and at the University of California-Berkley in 1987.

Hans William Schlegel, 41, will be Payload Specialist 2 (PS2). Nominated as a German astronaut in 1987, Schlegel was born in Oberlingen, Germany, and will be making his first space flight.

Schlegel graduated from Hansa Gymnasium in Cologne in 1970 and received a diploma in physics from the University of Aachen in 1979.

From 1979-1986, Schlegel was a member of the academic staff at Rheinisch Westfalische Technische Hochschule at the University of Aachen as an experimental solid state physicist. From 1986-1988, he was a specialist in non-destructive testing methodology in the research and development department of the Institut Dr. Førster GmbH and Co. KG in Reutlingen, Germany.

MISSION MANAGEMENT FOR STS-55

NASA HEADQUARTERS, WASHINGTON, D.C.

Office of Space Flight

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Bryan O'Connor - Deputy Associate Administrator
Tom Utsman - Space Shuttle Program Director
Leonard Nicholson - Space Shuttle Program Manager (JSC)
Col. Brewster Shaw - Deputy Space Shuttle Program Manager (KSC)

Office of Space Science and Applications

Dr. Lennard Fisk - Associate Administrator
Al Diaz - Deputy Associate Administrator
Robert Rhome - Director, Microgravity Science and Applications Division
Dr. Bradley Carpenter - Program Scientist, Microgravity Science and Applications Division
Joseph Alexander, Acting Director, Life Sciences Division
Dr. William Gilbreath, Program Manager, Life Sciences Division
Dr. Ronald White, Program Scientist, Life Sciences Division

Office of Safety and Mission Quality

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Charles Mertz - (Acting) Deputy Associate Administrator
Richard Perry - Director, Programs Assurance

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Bascom W. Murrah - Columbia Flow Director
J. Robert Lang - Director, Vehicle Engineering
Al J. Parrish - Director of Safety Reliability and Quality Assurance
John T. Conway - Director, Payload Management and Operations
P. Thomas Breakfield - Director, Shuttle Payload Operations

MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALA.

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Dr. J. Wayne Littles - Deputy Director
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Harry G. Craft, Jr. - Manager, Payload Projects Office
Dr. George McDonough - Director, Science and Engineering
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Otto Goetz - Manager, Space Shuttle Main Engine Project
Victor Keith Henson - Manager, Redesigned Solid Rocket Motor Project
Cary H. Rutland - Manager, Solid Rocket Booster Project
Parker Counts - Manager, External Tank Project

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Paul J. Weitz - Acting Director
Daniel Germany - Manager, Orbiter and GFE Projects
Dr. Steven Hawley - Acting Director, Flight Crew Operations
Eugene F. Kranz - Director, Mission Operations
Henry O. Pohl - Director, Engineering
Charles S. Harlan - Director, Safety, Reliability and Quality Assurance

STENNIS SPACE CENTER, BAY ST LOUIS, MISS.

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Gerald Smith - Deputy Director
J. Harry Guin - Director, Propulsion Test Operations

AMES-DRYDEN FLIGHT RESEARCH FACILITY, EDWARDS, CALIF.

Kenneth J. Szalai - Director
Robert R. Meyers, Jr. - Assistant Director
James R. Phelps - Chief, Shuttle Support Office.

DARA

Prof. Heinz Stoewer - Program Director
Wilfried Geist - Program Coordinator

DLR

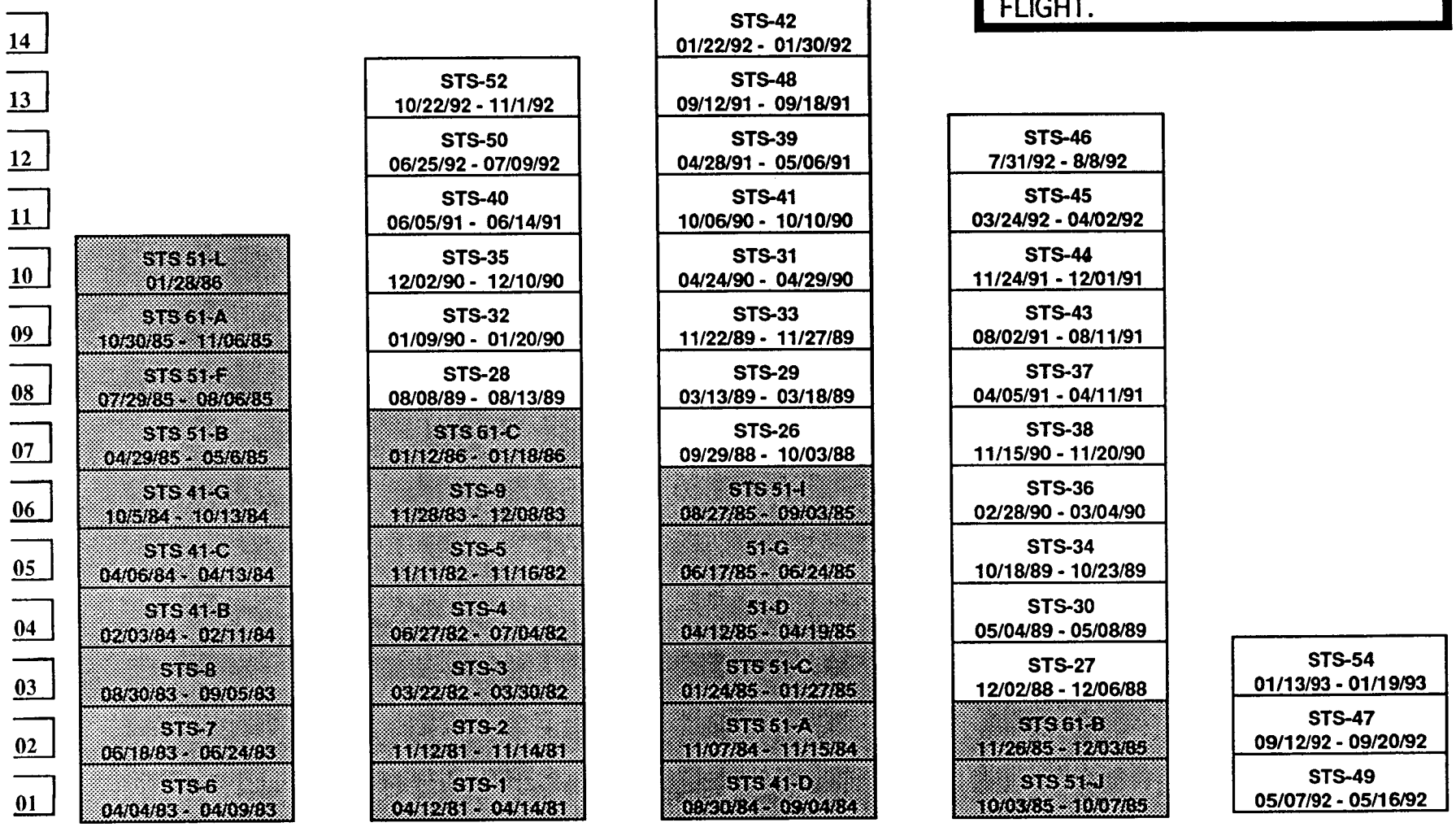
Prof. Dr. Walter Kroll - Chairman of Board of Director
Dr. Jurgen Beck - Director of Operations
Norbert Kiehne - Head of Management Department
Dr. Hauke Dodeck - D2 Mission Manager
Werner Gross - Head of Section D2 Administration
Hermann-Josef Kurscheid - Head of Section D2 Integration
Walter Brungs - Head of Section D2 Engineering
Reinhold Karsten - Head of Section D2 Payload Delopment andCoordination
Horst Schurmanns - Head of Section D2 Quality and Mission Assurance
Dr. Klaus Gardy - Head of Section D2 Operations
Ludger Frobel - Head of Section D2 Data Management
Prof. Dr. Peter Sahm - D2 Program Scientist
Dr. Manfred Keller - D2 Mission Scientist
Hans-Ulrich Steimle - Department Head Crew Operations
Dr. Raimund Lentzen - Head of Astronaut Office
Dr. Wolfgang Wyborny - Section Head of DLR Payload Operations
Dr. Franz-Josef Schlude - Head of Manned Space Control Center
Karl Friedl - MSCC D2 Coordination

ESA

F. Engstrom - Director of ESA Space Station and Microgravity Programme
G. Seibert - Head of Microgravity and Columbus Utilization Strategy and Planning Division
H. Martinides - Head of Microgravity Payload Division
K. Knott - Head of Columbus Interfaces and Payload Studies Division

SHUTTLE FLIGHTS AS OF JANUARY 1993

53 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM - 28 MISSIONS CONDUCTED SINCE RETURN TO FLIGHT.



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Washington, D.C. 20546
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Ed Campion
Headquarters, Washington, D.C.
(Phone: 202/453-8536)

James Hartsfield
Johnson Space Center, Houston
(Phone: 713/483-5111)

For Release
February 3, 1993

RELEASE: 93-21

SPACEWALK ADDED TO JULY SPACE SHUTTLE FLIGHT

A spacewalk has been added to Space Shuttle mission STS-51 aboard Discovery, set for a July launch, to continue extravehicular activity tests begun with the addition of a spacewalk to NASA's first 1993 Shuttle flight in January.

The STS-51 spacewalk is part of a series of tests NASA will conduct during the next 3 years to prepare for the construction and maintenance of Space Station Freedom, scheduled to be built in orbit starting in early 1996.

"The addition of the spacewalk to STS-51 will allow us to continue refining our knowledge of human performance capabilities and limitations during spacewalks", said Ron Farris, Chief of the Extravehicular (EVA) Section at the Johnson Space Center, Houston.

"This EVA constitutes a continuing committment by NASA to advance our preparation for future EVA missions such as the Hubble Space Telescope servicing and Space Station Freedom assembly flights," Ferris added. Other 1993 Shuttle flights remain under consideration for the addition of spacewalks as well.

The tests, as performed during STS-54 in January, concentrate on defining the limits of spacewalking abilities, better understanding of the differences between true weightlessness and the ground training facilities that simulate weightlessness and gaining more insight into the times required for various tasks to be performed while spacewalking. They also expand the experience levels among the astronaut corps, Shuttle flight controllers and spacewalk training instructors.

- more -

The specific tasks to be performed on STS-51 are still being evaluated by flight planners, however, the tasks will concentrate on these goals and be similiar to the tasks done during STS-54. The STS-51 spacewalk, as with the STS-54 spacewalk and future tests, will be done without any impact on the main objectives of the mission and will carry a low priority among the mission's tasks. STS-51's primary objective will be to deploy the Advanced Communications Technology Satellite. STS-51 crew members Jim Newman and Carl Walz will perform the spacewalk.

With the spacewalk performed in January and the one planned for July, a total of three Shuttle flights this year include spacewalks as now planned. Shuttle mission STS-61, scheduled aboard Endeavour in December to service several instruments and equipment on the orbiting Hubble Space Telescope, will feature several spacewalks. However, the STS-61 spacewalks are not part of the test series.

- end -

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For Release

Barbara Selby
Headquarters, Washington, D.C.
(Phone: 202/358-1983)

February 4, 1993

Rick Mould
University of Alabama in Huntsville
(Phone: 205/895-6414)

Mike Bryant
EER Systems, Vienna, Va.
(Phone: 703/847-5750)

Debbie Bingham
White Sands Missile Range, N.M.
(Phone: 505/678-1134)

RELEASE: 93-22

CONSORT 6 LAUNCH DATE SET

A commercial suborbital rocket carrying seven experiments has been set for launch at 1 p.m. EST, on Feb. 19, by the University of Alabama in Huntsville's Consortium for Materials Development in Space (UAH CMDS).

EER Systems Corp., Vienna, Va., will launch the Consort 6 from theWhite Sands Missile Range (WSMR), N.M., from White Sands Missile Range (WSMR), N.M., using its two-stage solid fuel Starfire 1 rocket. The launch will be conducted through the Naval Air Warfare Center Weapons Division-White Sands Detachment. The rocket will carry the payload to an altitude of 200 miles, providing the experiments with 7 to 8 minutes of microgravity.

Managed by the UAH CMDS, a NASA Center for the Commercial Development of Space (CCDS), the Consort rocket and launch services are funded by a grant from the space agency's Office of Advanced Concepts and Technology.

The Consort 6 experiments, focusing on the effects of microgravity on various processes, materials and biomedical samples, will be conducted by UAH CMDS and another NASA CCDS, theCenter for Cell Research (CCR) at the Pennsylvania State University.

-more-

The CCR will examine various biological samples using its Biomodule. The experiment will study the effects of microgravity on amphibian skin tissue. The processes to be examined in the experiment are identical to those in the human body used for the release of hormones for proper health.

The UAH CMDS and several industry partners will conduct experiments studying the effects of the low gravity environment on different materials:

• The UAH CMDS experiments include two foam experiments with Thiokol Corp., Logan, Utah. The experiments will form foam into specific shapes to study the use of foam as a building material and insulator in space.

* Kennametal, Inc., Greensburg, Pa., and the UAH CMDS will use a high-temperature furnace in a liquid phase sintering experiment and will capture a ceramic mix in a special hydraulic compacting device in a powdered materials processing experiment.

* Space Hardware Optimization Technology, Floyd Knobs, Ind., and Interfacial Dynamics Corp., Portland, Ore., will team with the UAH CMDS on an organic separation experiment. The experiment will focus on improving purification techniques for certain
biotechnology materials.

* An electrodeposition experiment , using nickel and cobalt , will be conducted by the UAH CMDS and McDonnell Douglas Aerospace, Huntsville. The experiment will help find metals and alloys with enhanced corrosion resistance, surface hardening and catalystical properties. McDonnell Douglas also provides the Consort 6 payload integration.

-end-

EDITORS NOTE: A prelaunch photo opportunity and informal briefing is scheduled for 9:30 a.m. (local time), Feb. 18, at WSMR.

Requests for accreditation to attend the launch and related activities should be submitted by Feb. 11 to:

Debbie Bingham, PAO
Building 122
White Sands Missile Range, NM 88002-5057
(Phone: 505/678-1134)

Radio and television reporters planning live coverage directly from the range are required to coordinate their transmission frequencies with WSMR by Feb. 12 so they may be cleared for use.

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For Release

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Headquarters, Washington, D.C.
(Phone: 202/453-8613)

Lori Rachul
Lewis Research Center, Cleveland
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February 5, 1993

RELEASE: 93-23

NASA RESEARCHER TAPPED FOR OHIO SCIENCE HALL OF FAME

Dr. Lonnie Reid, a nationally-known fluid dynamics expert at NASA's Lewis Research Center, Cleveland, will be inducted into the Ohio Science, Technology and Industry Hall of Fame in Columbus on Feb. 7.

Reid, who will be the first NASA researcher and one of three African Americans in the Hall of Fame, is being honored for his pioneering work in integrating theoretical and experimental methods in the science of fluid dynamics. Fluid dynamics is the study of the interaction between fluids and objects, such as air flowing though the various parts of a jet engine.

"Lonnie Reid's efforts to advance aerospace propulsion are just what the nation expects from NASA -- solving difficult problems through technology development," said NASA Administrator Daniel S. Goldin. "He is not only a leader in research, but also a role model for the young engineers of the future."

Ohio's Center Of Science & Industry established the Hall of Fame in 1990 to recognize Ohioans who have made major scientific and technological contributions. Reid is among 12 persons being inducted this year. Others in the Hall of Fame include Thomas Edison and the Wright Brothers.

As head of Lewis' Fluid Dynamics Division, Reid leads the center's efforts to analyze and experiment with air flows and temperatures inside advanced aerospace propulsion systems. He is considered a leading U.S. expert on turbomachinery technology.

- more -

Reid's service at Lewis Research Center spans 31 years. He received the NASA Exceptional Service Medal in 1989 and has two NASA Group Achievement Awards. He has written more than 25 technical papers on the design, analysis and performance of transonic compressors for advanced gas turbine engines.

Reid earned a bachelor's degree in mechanical engineering from Tennessee State University in 1961. He received a master of science degree in mechanical engineering in 1972 and a doctorate in engineering science in 1990, both from the University of Toledo.

-end-

NOTE TO EDITORS: A photo of Dr. Reid is available from the Lewis Research Center Media Relations Office, 216/433-8806.

NASA News
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AC 202 358-1600

For Release

Paula Cleggett-Haleim
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

February 8, 1993

Jim Sahli/Dave Drachlis
Marshall Space Flight Center, Huntsville, Ala.
(Phone: 205/544-0034)

RELEASE: 93-024

ASTROPHYSICIST NAMED 1992 NASA INVENTOR OF THE YEAR

A NASA astrophysicist whose work in developing x-ray telescopes led to his invention of a revolutionary new microscope, has been named NASA Inventor of the Year for 1992.

Richard B. Hoover of the Marshall Space Flight Center, Huntsville, Ala., was selected for his invention of the Water-Window Imaging x-ray Microscope. This instrument should enable researchers to see in great detail high contrast x-ray images of proteins, chromosomes and other tiny carbon structures inside living cells. Resolution of the microscope could be so high that it may produce detailed images of the building blocks of life -- tiny DNA molecules.

"I believe the microscope has immense potential in many biological and medical research areas," Hoover said. These include genetic and gerontology research; gene splicing and genetic engineering; cancer research and early tumor cell diagnostic imaging; AIDS research including analysis of the viral structure of HIV and assessment of real time interactions of influencing drugs and antibodies; and chemical drug analysis.

The device uses x-rays instead of visible light to create ultra-high resolution, high-contrast images.

Will See Things Never Seen Before

The Microscope got its "water-window" name because it is designed to operate in a narrow band of the x-ray part of the electromagnetic spectrum at which water transmits or passes x-rays and appears transparent, and carbon absorbs x-rays and becomes opaque. In this "window" between 23.3 and 43.7 angstroms, the microscope can produce detailed images of the important carbon structures inside a living cell, which is made up primarily of water.

- more -

Above this "window," carbon becomes more transparent to x-rays so carbon structures will not show up. Below the "window," water absorbs x-rays and becomes opaque, obscuring the carbon structures inside the cell.

"This instrument essentially will allow us to see through the water and into the living cell with very high resolution and high contrast, without using dyes or stains which produce limitations," explained Hoover. "When development is complete and cell biologists begin using the microscope, it is possible that they will begin seeing things they have never seen before."

The advance in capability provided by the microscope may be as great as the difference between a doctor looking at a conventional photograph and a doctor looking at an x-ray picture of the human body, according to Hoover.

Hoover is a member of the Solar-Terrestrial Physics Division of the Marshall Center's Space Science Laboratory. A veteran of 27 years with the center, his primary research has been devoted to development of advanced x-ray imaging systems. He has contributed significantly to improved technologies for x-ray optics.

Most recently, he was instrumental in the development of a new kind of solar x-ray telescope. Launched aboard sounding rockets in 1987 and 1991, the solar x-ray telescopes have produced some of the highest resolution x-ray images ever taken of the sun. Hoover found that the new optics technologies developed for this x-ray telescope could be applied to the development of a high resolution x-ray microscope.

In addition to his work at NASA, Hoover has devoted time to research in other disciplines. He is an internationally recognized authority on photomicroscopy and the micropaleontology of diatoms (a microscopic single-cell algae).

He graduated with honors from Henderson State University in Arkadelphia, Ark., in 1964 with a bachelor of science degree in physics and mathematics. He was a physics instructor at the University of Arkansas from 1965 to 1966 and later studied optics at the University of California at Los Angeles and the University of Alabama in Huntsville. He is married to the former Miriam Jackson.

Hoover was selected to receive the Inventor of the Year Award by NASA's General Counsel Office, Headquarters, Washington, D.C.

- end -

EDITOR'S NOTE: Photos and a video news release of Richard B. Hoover and the Water-Window Imaging X-Ray Microscope are available from the Marshall Space Flight Center Newsroom by calling 205/544-0034.

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For Release

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Headquarters, Washington, D.C.
(Phone: 202/358-0883)

February 9, 1993

Diane Farrar
Ames Research Center, Mountain View, Calif.
(Phone: 415/604-3934)

RELEASE: 93-025

NASA SCIENTISTS SOLVE LONG-STANDING STELLAR MYSTERY

Space scientists at NASA's Ames Research Center, Mountain View, Calif., believe they have solved an 80-year-old mystery: What unidentified matter in deep space is absorbing certain wavelengths of light from distant stars?

By mimicking realistic interstellar conditions in a laboratory, Drs. Farid Salama and Louis Allamandola have shown that the light is absorbed by unexpectedly large organic molecules spread throughout the vacuum of space. The carbon-based molecules, shaped like chicken wire, are called polycyclic aromatic hydrocarbons (PAHs).

Their experiments may have resolved one of the longest standing mysteries of 20th century astronomy, according to Dr. David J. Helfand of Columbia University in New York.

For nearly a century, scientists have wondered what causes the unidentified absorption lines in the spectra (range of frequencies or color, for instance the band of color produced when sunlight is passed through a prism, such as a rainbow) of starlight reaching the Earth. The lines are called diffuse interstellar bands (DIBs) and now number more than a hundred.

An important breakthrough came a decade ago. Observations of infrared radiation obtained from Ames' Kuiper Airborne Observatory led Allamandola and others to believe that a form of PAHs might be the long-sought matter. "They could easily withstand the intense radiation environment of interstellar space," he said.

PAHs are stable carbon molecules formed at high temperatures. On Earth, they cause pollution and cancer. PAHs can be a by-product of cooking and combustion. They are found in burned pots, charcoaled hamburgers, bus exhaust and cigarette smoke. The oil fires in Kuwait produced large quantities of PAHs.

- more -

Although the Ames group suspected PAHs could be causing the mysterious spectroscopic "fingerprints" (DIBs), there was a catch. "In space, PAHs would be electrically charged (ionized) and very reactive. This form of matter is extremely difficult to study in the laboratory," Allamandola said.

Salama's experiments successfully reproduced the ionized molecules under the most authentic interstellar conditions possible. Because the molecules are highly reactive, isolating them from the subtle effects of their surrounding chemical environment was difficult. Studying them in a near vacuum, as they exist in space, was impossible. Salama used solid, neon to isolate them at very low temperatures.

The PAHs' spectroscopic visible light fingerprint in Salama's experiments closely matched those from interstellar space. Independent observations by other scientists -- now knowing what to look for -- support his conclusions.

"These molecules are one of the largest sources of carbon-rich material in the vast distances between the stars. They account for 5 to 10 percent of all cosmic carbon," Salama said.

"Until a few years ago, we would not have imagined that molecules this complex existed in space. In the whole chemistry of the interstellar medium, we've been lucky to find several atoms bound together," Allamandola said. "Larger molecules, containing up to about 12 atoms have been found. The larger the molecules, usually the less abundant they are.

"Then suddenly we find these monstrous molecules, containing between 20-100 carbon atoms. Larger PAHs must be present as well. They are spread throughout space and, except for hydrogen and carbon monoxide, they're more abundant than all the known interstellar molecules taken together.

"We think PAHs are the by-product of old carbon-rich stars burning out. This challenges the traditional view of interstellar chemistry, which assumes that all interstellar molecules are produced in the interstellar medium," he said.

"The experiments had another surprising result," Salama said. "For years, scientists have observed large amounts of unexplained long-wave (infrared) radiation in space. Because we found that charged PAHs absorb a lot more ultraviolet and visible radiation in space than expected, we think they may be the valve turning higher frequency waves (ultraviolet-visible) into longer wavelength infrared. We think they play a central role in determining the radiant energy balance of interstellar space," he said.

Their results also may influence the theory of solar system formation. PAHs found in meteorites are thought to be produced by heat from repeated collisions of solid material early in solar system formation. Now it seems at least some of these complex organic molecules came from interstellar space and were original ingredients in the nebula which produced the sun and planets.

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For Release

Brian Dunbar
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

February 11, 1993

Mary Gannon
American Association for the Advancement of Science, Washington, D.C.
(Phone: AAAS Newsroom, 617/236-6131)

RELEASE: 93-26

AAAS TO HONOR NASA SCIENTIST FOR OZONE RESEARCH

NASA scientist Dr. Robert Watson will receive the Scientific Freedom and Responsibility Award from the American Association for the Advancement of Science (AAAS) on Monday, Feb. 15.

The AAAS will honor Dr. Watson, Director of the Process Studies Program Office in NASA's Earth Science and Applications Division, Headquarters, Washington, D.C., and Dr. Dan Albritton of the National Oceanic and Atmospheric Administration (NOAA) for their contributions to the scientific and policy discussions on global ozone depletion.

The AAAS cited Dr. Watson and Dr. Albritton "for their leadership in gaining international scientific consensus on threats to the stratospheric ozone layer that laid the groundwork for the signing of the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer."

Under Watson and Albritton, research by NASA, NOAA and other U.S. and international organizations helped establish that chemical byproducts of human industry are causing significant depletion of ozone high in the atmosphere. This depletion increases the risk of skin cancer and cataracts and raises questions about possible damage to food crops and the microscopic organisms that are an important part of the ocean food chain.

International scientific assessments, several of which Dr. Watson chaired, led to a nearly global consensus to phase out chemicals that deplete ozone.

- more -

Dr. Watson, who received his Ph.D. in chemistry from London University in 1973, was also the U.S. representative to the Intergovernmental Panel on Climate Change Science Working Group.

The award will be presented at the society's annual meeting at the Sheraton Boston Hotel & Towers, Boston. The Scientific Freedom and Responsibility Award honors scientists and engineers whose actions protected the public's welfare, furthered public policy debates, fulfilled the social responsibility of scientists and engineers or defended scientists' professional freedom.

- end -

NASA News

National Aeronautics and
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For Release

Ed Campion
Headquarters, Washington, D.C.
(Phone: 202/358-1778)

February 11, 1993

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NOTE TO EDITORS: N93-7

STS-55 REVIEW COMPLETED, LAUNCH DATE TO BE SET LATER

NASA managers today completed their review of the flight readiness of Shuttle Mission STS-55, a mission dedicated primarily to the German Space Agency for research in life and microgravity sciences.

Because of a decision reached yesterday to remove and replace Columbia's high pressure oxidizer pumps, a launch date for the mission was not set. Managers are still assessing the time it will take to perform the work and resume launch preparations. Tom Utsman, Director of the Space Shuttle Program, said a launch date for STS-55 would be set the last week in February.

The pumps being replaced feed super cold oxygen to the Shuttle's three main engines. They are being removed because a search of processing paperwork could not conclusively determine that the pumps are equipped with a newer version of turbine tip seal retainers. The tip seals minimize the flow of gas around the tips of the turbine blades to enhance pump performance and the retainers hold the seals in place.

The major payload for Space Shuttle Columbia and her 7 member crew is the pressurized Spacelab module - designated Spacelab-D2 - which will allow the astronauts to conduct a wide range of experiments in the microgravity environment of space. Some 90 experiments are planned during the mission.

This will be the 14th flight of the orbiter Columbia and the 54th Space Shuttle mission.

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February 11, 1993

RELEASE: 93-027

NASA SELECTS 11 DISCOVERY MISSION CONCEPTS FOR STUDY

NASA today announced the selection of 11 new science mission concepts in the Discovery Program which have been identified for further study during this fiscal year.

The mission candidates were selected from 73 concepts discussed at the Discovery Mission Workshop held at the San Juan Capistrano Research Institute in San Juan Capistrano, Calif., last Nov. 16-20. The potential projects were those considered to have the highest scientific value as well as a reasonable chance of meeting strict budgetary guidelines.

Discovery missions are designed to proceed from development to flight in less than 3 years, combining well-defined objectives, proven instruments and flight systems, costs limited to no more than $150 million and acceptance of a greater level of risk.

"These missions represent a bold new way of doing business at NASA," said NASA Administrator Dan Goldin. "By accepting a greater level of risk, we can deliver high-return missions that are cost-effective, quicker from concept to launch, and responsive to the present budget climate. They promise to revolutionize the way we carry out planetary science in the next century."

"The Discovery Program is probably the most exciting new initiative in planetary exploration," said Dr. Wesley T. Huntress, Jr., Director of NASA's Solar System Exploration Division.

"We now will be able to more effectively take advantage of emerging technology and quickly - and relatively cheaply - undertake more new missions of discovery than at anytime since the beginning of the space age. Also, because of the shorter time frames and lower costs, these missions will allow greater participation from the academic and aerospace communities," Huntress said.

- more -

The 11 mission concepts to be studied are:

• **Mercury Polar Flyby** has an objective to study the polar caps and complete the photographic reconnaissance of the planet. Principal Investigator: Paul D. Spudis, Lunar and Planetary Institute, Houston.

• **Hermes Global Orbiter to Mercury** involves remote sensing of the planet's surface, atmosphere and magnetosphere. Principal Investigator: Robert Nelson, Jet Propulsion Laboratory, Pasadena, Calif.

• **Venus Multiprobe Mission** involves placement of 14 small entry probes over one hemisphere of Venus to measure winds, temperature and pressure. Principal Investigator: Richard Goody, Harvard University, Cambridge, Mass.

• **Venus Composition Probe** enters Venus' atmosphere in daylight to measure atmospheric structure and composition on a parachute descent. Principal Investigator: Larry W. Esposito, University of Colorado, Boulder.

• **Cometary Coma Chemical Composition** aims to rendezvous with a cometary nucleus at or near perihelion and conduct 100 days of scientific operations. Principal Investigator: Glenn C. Carle, NASA Ames Research Center, Mountain View, Calif.

• **Mars Upper Atmosphere Dynamics, Energetics and Evolution Mission** will study Mars' upper atmosphere and ionosphere. Principal Investigator: Timothy Killeen, University of Michigan, Ann Arbor.

• **Comet Nucleus Tour** involves study of three comets during a 5-year mission, focusing on structure and composition of the nucleus. Principal Investigator: Joseph Veverka, Cornell University, Ithica, N.Y.

• **Small Missions to Asteroids and Comets** involves four separate spacecraft launches to study distinctly different types of comets and asteroids. Principal Investigator: Michael Belton, National Optical Astronomy Observatories, Tuscon, Ariz.

• **Near Earth Asteroid Returned Sample** will acquire samples from six sites on a near-Earth asteroid and return them to Earth for study. Principal Investigator: Eugene Shoemaker, U.S. Geological Survey, Flagstaff, Ariz.

• **Earth Orbital Ultraviolet Jovian Observer** will study the Jovian system from Earth orbit with a spectroscopic imaging telescope. Principal Investigator: Paul Feldman, Johns Hopkins University, Baltimore.

• **Solar Wind Sample Return** mission aims at collecting and returning solar wind material to Earth for analysis. Principal Investigator: Don Burnett, Calif. Institute of Technology, Pasadena.

In addition, three concepts also were targeted for further consideration this fiscal year. They are:

• **Mainbelt Asteroid Rendezvous Explorer** would rendezvous and orbit the mainbelt asteroids Iris or Vesta. Principal Investigator: Joseph Veverka, Cornell University, Ithica, N.Y.

• **Comet Nucleus Penetrator** would rendezvous with a comet and deploy a penetrator into its nucleus. Principal Investigator: William V. Boynton, University of Arizona, Tuscon.

• **Mars Polar Pathfinder** involves a lander which will carry out subsurface exploration of the northern Martian polar cap by radar and a probe to measure ice quantities and temperature. Principal Investigator: David A. Paige, University of Calif. at Los Angeles.

"It was a difficult task narrowing the list down," said Dr. Richard Vorder Bruegge, a member of the Discovery Advanced Study Review Group which made the selections.

A formal competition to make final selections of the missions to be conducted will be announced possibly next year.

"The formal selection process will be open to all interested parties. Anyone will be able to submit a proposal for a Discovery mission in the formal competition," said Vorder Bruegge. "These proposals will have to be more extensive than the studies and include science rationale, spacecraft design, observations, data systems -- a start-to-finish proposal for a new mission."

The 11 mission concepts selected follow the first two Discovery missions selected for Phase A studies last year. They are the Mars Environmental Survey (MESUR) Pathfinder, planned for launch in 1996, and the Near Earth Asteroid Rendezvous (NEAR), planned for a 1998 launch.

Phase A studies of the MESUR Pathfinder mission was awarded to NASA's Jet Propulsion Laboratory, Pasadena, Calif. (JPL). The Applied Physics Laboratory of Johns Hopkins University, Baltimore, Md. (APL), has been awarded Phase A studies of the NEAR mission.

MESUR Pathfinder is envisioned as a technical demonstration and validation flight for the MESUR program, scheduled to begin in 1999. The MESUR program calls for building a network of about 16 small automated surface stations widely scattered around Mars to study the planet's internal structure, meteorology and local surface properties.

NEAR would spend up to a year station-keeping with a near-Earth asteroid. The NEAR spacecraft, probably carrying only three instruments, would assess the asteroid's mass, size, density and spin rate, map its surface topography and composition, determine its internal properties and study its interaction with the interplanetary environment.

"The study of planets provides other planetary examples against which to compare our own Earth, in order to understand better how planet Earth works and how it behaves," said Huntress. "The study of the solar system, and the planetary bodies within it, also will help us to understand how our solar system formed, how other solar systems might form around other stars, and therefore lead us to answer whether or not there are other Earths and other life in the universe.

"To understand the uniqueness of the Earth, we need to understand the other rocky planets in the solar system -- Mercury, Venus and Mars. To find clues to the origin and evolution of the solar system we need to examine and return samples from the oldest and most primitive objects in the solar system -- comets and asteroids," Huntress said.

The Discovery Program is managed by the Solar System Exploration Division of the Office of Space Science and Applications, NASA Headquarters, Washington, D.C.

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EDITOR'S NOTE: The Discovery Program Workshop Summary report, containing a list of the 73 mission concepts presented at the Discovery Mission Workshop at La Jolla, Calif., is available by calling the NASA Headquarters Newsroom at 202/358-1600.

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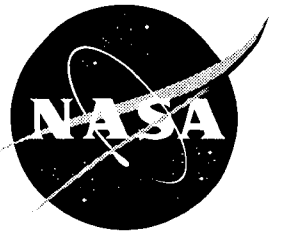

For Release

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February 11, 1993

RELEASE: 93-28

ASTRO-D MISSION TO LAUNCH TONIGHT IN JAPAN

Astro-D, a cooperative x-ray astronomy mission with Japan's Institute of Space and Astronautical Science (ISAS) and NASA, is scheduled for launching tonight, Feb. 11 at 9 p.m. EST, from the ISAS Kagoshima Space Center in Japan.

Astro-D has been specifically designed to help understand the physics of a variety of cosmic sources. With its high sensitivity and high spectroscopic capability, the investigations with Astro-D will span virtually all classes of astronomical objects. Astro-D is expected to make important contributions to the advancement of astrophysics and cosmology.

"We have done x-ray astronomy investigations with better imaging characteristics and have done others with better spectroscopic sensitivity," said Dr. Steve Holt, Astro-D Project Scientist, NASA's Goddard Space Flight Center, Greenbelt, Md. "But combining relatively modest imaging performance with powerful spectroscopic sensitivity gives us the ability to perform literally thousands of observations that we could not do before."

This high-capability x-ray observatory will launch on an ISAS M-3SII rocket into a circular orbit, approximately 340-409 miles (550-650 kilometers) above the Earth.

The observatory combines the conical-foil mirror technology of the Broad Band X-Ray Telescope (BBXRT), which flew on the Space Shuttle Columbia in December 1990, with the Charge Coupled Device (CCD) detector technology being developed for the Advanced X-Ray Astrophysics Facility (AXAF), to perform imaging spectroscopy in the wavelength band from less than 1 KeV (1000 electron volts) to 12 KeV.

- more -

The observatory is equipped with four sets of conical, grazing incidence, thin-foil x-ray mirrors provided by Goddard. The mirror technology was developed by Dr. Peter Serlemitsos and his Goddard colleagues.

The Massachusetts Institute of Technology, under the leadership of Dr. George Ricker, is providing two CCD-based detectors. Japan is providing the balance of the science payload, the spacecraft, the launch vehicle and overall program management. The Astro-D software was developed by a team of Japanese and U.S. scientists from ISAS, Goddard and U.S. and Japanese universities.

During early operations, the four telescopes will point at approximately two targets per day. This will be increased to as many as six per day by the end of the first year of operation. These targets will include supernova remnants, stars, neutron stars, black holes, active galactic nuclei and clusters of galaxies.

A significant portion of the Astro-D observing time will be made available to international investigators. Under the guest observer program, 60 percent of the observing time is allotted to Japanese observers, 15 percent to U.S. observers and 25 percent for collaborative U.S./Japan observations.

The approximate U.S. cost for the development of the Astro-D mission is $10 million, which is less than 10 percent of the equivalent Japanese contribution to the mission. The U.S. portion of the Astro-D mission is managed by Goddard for NASA's Office of Space Science and Applications, Washington, D.C.

- end -

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For Release

February 16, 1993

RELEASE: 93-029

NASA CO-SPONSORS HIGH-TECH SMALL BUSINESS CONFERENCE

Small, minority-owned and women-owned businesses can obtain information on how to do business with NASA and other government agencies at the 1993 High Technology And Small Business Development Procurement Conference on March 1-2 in Los Angeles.

NASA, the Jet Propulsion Laboratory (JPL), Pasadena, Calif., and the Southern California Small Business Utilization Council are co-sponsoring the fifth annual conference at the Hyatt Hotel-Los Angeles International Airport, Los Angeles.

About 200 government prime contractors, federal agencies and other large procurement organizations are expected to participate in the conference. They will offer guidance on contracting opportunities, particularly in the form of requests for quotations, requests for proposals and invitations to bid.

There will be seven workshops as well as marketing and networking opportunities. Workshop topics will include "When You Can Negotiate"; "The Proposal Evaluation Process"; "Performance Expectations"; "How To Reach The End Users Before Buyers Receive A Requisition"; "Total Quality Management"; "Legislation And Public Laws Impacting Small/Small Disadvantaged Businesses"; and "How To Do Business With The Federal Government."

For more information or to receive an invitation to the conference, contact Andrew Guyton at JPL's Contractor Capabilities Office at 818/354-7531 or Eugene Rosen, NASA Headquarters Office of Small and Disadvantaged Business Utilization Office at 202/358-2088.

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For Release
February 17, 1993

RELEASE: 93-030

NASA STUDY MAY HELP REDUCE LIGHTHEADEDNESS AFTER SPACE FLIGHT

A study at NASA's Ames Research Center, Mountain View, Calif., may lead to improved ways of keeping astronauts from feeling faint when they stand after returning to Earth from space.

Dr. Joan Vernikos, the study's principal investigator, said a reduced level of plasma is believed to contribute to this tendency to feel faint. Plasma is the fluid part of the blood, without blood cells.

"The primary purpose of this study is to compare the effectiveness of two procedures that expand plasma volume," said Vernikos, Chief of Ames' Life Science Division.

"We long have known that expanded plasma volume may be a key to preventing fainting in people following head-down bed rest and potentially, in astronauts," she said. Bed rest in a slightly head-down position simulates many of the physiological effects of weightlessness.

Vernikos said that without the pull of Earth's gravity, astronauts experience an upward shift of body fluids. The body responds to what it perceives as excess fluid and reduces the amount of circulating fluid volume by excreting more urine.

Upon return to the normal gravity of Earth, fluids again shift to the lower extremities. This increases the chance an astronaut will feel lightheaded immediately after landing, she said.

By finding reliable and acceptable means of increasing the plasma volume in volunteers, Vernikos believes much of this light-headedness can be prevented.

Space Shuttle crews routinely take water and salt tablets just before re-entry. Vernikos said this is believed to expand plasma volume in astronauts in space, but it has never been measured.

- more

"We don't know by how much and for how long the expansion of plasma lasts, especially in the weightless state when the body's normal response is to excrete excess fluid," she said.

"We also have had promising results with a synthetic steroid similar to steroids normally found in the body," Vernikos said. This steroid, which produces the same effect as the salt tablets and water, may provide a more reliable alternative, particularly as mission lengths increase. It is used clinically to treat people who faint or experience sudden bouts of low blood pressure when they stand, she said.

Her study involves six women and six men ages 30 to 50. Plasma volume is measured in each person under three conditions: after taking water and salt tablets, after taking the synthetic steroid or after no medication.

Two hours after each treatment, the volunteer lies quietly for 30 minutes. A blood sample is drawn and a dye is injected into the volunteer, then a second sample is drawn for the measurement of plasma volume. The volunteer then stands for 15 minutes and additional blood samples are drawn 5 and 15 minutes after standing. Blood samples will be used to measure the hormones that regulate sodium and fluids. Blood pressure and heart rate responses to standing also are measured.

The study will add to the limited data about how women adapt to space flight. Although women also serve as astronauts, data from flight and ground-based simulation studies are derived almost exclusively from men, Vernikos said. "The very few studies that have included women suggest that they tolerate and adapt to head-down bedrest as well as men," she said.

Responses to the treatments may vary not only by sex, but also with the time of day, she added. Vernikos will measure the effectiveness of both treatments during the day and at night. "Our purpose is to find the most effective treatment and the minimum effective dose, with the least side effects, for both sexes," she said. "It is very important that we have this information before we test drugs of any kind on astronauts in space."

Previous studies have shown that all people with a tendency to faint have some common characteristics, Vernikos said. These include a higher plasma volume under everyday resting conditions. In addition, various hormones that constrict blood vessels and raise blood pressure when the person stands up are less effective in fainters. After bedrest or space flight, these characteristics are aggravated. Besides expanding plasma volume, the steroid also may boost these mechanisms.

Drs. Mary F. Dallman and Lanny Keil of the University of California, San Francisco, are co-investigators. Dee O'Hara, Manager of Ames' Human Research Facility, is coordinating the study.

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For Release
February 17, 1993

RELEASE: 93-31

SPACEWALK ADDED TO APRIL SPACE SHUTTLE FLIGHT

A spacewalk has been added to Space Shuttle mission STS-57 aboard Endeavour, set for an April launch, as part of a series of spacewalk tests NASA will conduct during the next three years to prepare for the construction and maintenance of Space Station Freedom.

The main objectives of the STS-57 mission are to retrieve the European Retrievable Carrier (EURECA) deployed during a Shuttle flight in August 1992 and to conduct research in the Spacehab module which more than doubles the amount of middeck research locker space aboard the orbiter.

In addition to accomplishing the general objectives of the spacewalk test series, the STS-57 extravehicular activity (EVA) will allow some of the spacewalking procedures, using the Shuttle's mechanical arm, planned for use in servicing the Hubble Space Telescope (HST), to be tested. Those procedures involve work by astronauts on a platform at the end of the Shuttle's arm. The arm will be aboard Endeavour for grappling the EURECA satellite.

"The EVA will benefit us in two ways: first, we'll gather generic data on human performance capabilities and limitations in space and secondly, we'll perform some tasks similiar to those required for the HST mission later this year," said Ron Farris, Chief of the Extravehicular Section at the Johnson Space Center."

-more-

"We'll also demonstrate that the EVA community can plan, train and fly four missions this year and in that sense, it will be a banner year for EVA and will be somewhat representative of the EVA efforts required to build and maintain Space Station Freedom," Farris added.

The spacewalk tests, as performed during STS-54 in January, concentrate on defining the limits of spacewalking abilities, better understanding the differences between true weightlessness and the ground training facilities that simulate weightlessness and gaining more insight into the times required for various tasks to be performed while spacewalking. The tests also expand the spacewalk experience levels among the astronaut corps, Shuttle flight controllers and spacewalk training instructors.

The specific tasks to be performed on STS-57 are still being evaluated by flight planners, however they will concentrate on these goals and be similiar to the STS-54 tasks although they will feature use of the robot arm. The STS-57 spacewalk, as with the STS-54 spacewalk and other such spacewalk tests will be done without any impact on the mission's main objectives and will carry a low priority among the mission's tasks.

STS-57 crew members G. David Low and Jeff Wisoff will perform the EVAs.

With the spacewalk performed in January, those planned for April and July and the spacewalks planned for the STS-61 HST servicing mission in December, a total of four Shuttle flights this year feature spacewalks.

Four Shuttle missions with planned spacewalks in one year ties a NASA record for missions with EVAs set when four spacewalk missions were flown in 1984.

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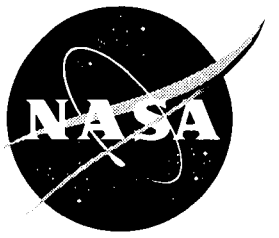

For Release

Don Savage
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February 18, 1993

RELEASE: 93-32

NASA BUDGET BOOSTS TECHNOLOGY, PROMISES IMPROVED SPACE STATION PROGRAM

The President's 1994 budget request for NASA will call for an increase over last year's budget with key provisions for the Space Station program and the development of important new technologies.

NASA Administrator Daniel S. Goldin praised the plan, saying, "It clearly reflects the President's firm commitment to a meaningful and balanced space program and the revitalization of American industry through cutting-edge science and technology development."

President Clinton has directed the Administrator to redesign the Space Station as part of a program that is more efficient and effective and capable of producing greater returns on our investment. The '94 package provides $2.3 billion for the smooth transition of the program to a streamlined, cost-effective design, assuring stability in the program during the transition and minimizing any potential job loss.

The President also has directed NASA to work closely with the U.S. Congress and international partners to maintain continuity in the program and to assure their participation in producing a space station that is technically challenging and promises the highest possible returns.

NASA's new technology investment package will provide significant funding aimed at new projects that could lower the cost of space research, achieve demonstrable results sooner and are more directly beneficial to the economy. The new plan allows room in NASA's budget for future enhancements to ongoing agency efforts in aeronautics, human and robotic space flight and the transfer of technology to new and existing industries.

Goldin was briefed by White House officials late Wednesday and Thursday morning and offered the following statement:

- more -

"I congratulate the President on his courageous vision of an aeronautics and space program that is relevant to America and continues to lead the world in innovation and discovery."

"In response to the vision, we will join with our international partners, industry experts, and the science community to introduce broad, innovative thinking to the process of delivering a meaningful and efficient program to the American people and to the world."

"I have great faith and pride in the working women and men of the NASA team who I know will step up to the challenge to do more with less, just as they have met the great challenges of the past."

"NASA will serve the President's vision and live up to its reputation as a can-do agency by becoming a model in government for quality, efficiency and productivity."

- end -

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For Release

Charles Redmond
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February 19, 1993
4 P.M. EST

RELEASE: 93-33

NASA SELECTS SMALL BUSINESS INNOVATION RESEARCH PROJECTS

NASA announced today the selection of 111 research proposals for immediate negotiation of Phase II contracts in NASA's Small Business Innovation Research Program (SBIR).

These proposals, along with 38 previously selected on Jan. 6, came from 130 small, high technology firms located in 27 states, with California and Massachusetts firms submitting the largest number of winning proposals P 34 from California and 28 from Massachusetts. Other states with more than one winning proposal include Colorado (11), Maryland (9), Virginia (8), New York (6), and Texas (5).

The selections were made competitively from 267 proposals submitted for Phase II continuations of SBIR Phase I projects initiated in 1991. The Phase II contracts continue development of the most promising Phase I projects which have demonstrated a technical feasibility and which also have a potential value to NASA as research innovations. Funding for each of the Phase II winning proposals can be as much as $500,000 over a period up to 2 years.

The Small Business Innovation Research Program is intended to stimulate technological innovation by using small businesses, including minority and disadvantaged firms, to help meet federal research and development requirements and to encourage the commercial application of federally-funded research innovations.

NASA's program is managed by the Office of Advanced Concepts and Technology, Headquarters, Washington, D.C. The individual SBIR contracts are managed by NASA centers.

- end -

EDITOR'S NOTE: A listing of companies selected for this program is available at the NASA Headquarters newsroom by calling 202/358-1600 and at NASA centers.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

93-34

SPACE SHUTTLE MISSION

STS-56

PRESS KIT

~~MARCH~~ APRIL 1993

ATLAS - 2

ATMOSPHERIC LABORATORY FOR APPLICATIONS AND SCIENCE

CONTENTS

RELEASE: 93-34 March 1993

STS-56 MISSION CONTINUES NASA'S MISSION TO PLANET EARTH

A variety of scientific questions will be addressed when NASA conducts Shuttle mission STS-56 in late March 1993. The crew on Space Shuttle Discovery will gather data on the relationship between sun's energy output and Earth's middle-atmosphere chemical make-up and how these factors affect the Earth's ozone level.

The crew will use the Atmospheric Laboratory for Science and Applications (ATLAS 2) and Shuttle Backscatter Ultraviolet (SSBUV) payloads aboard Discovery to gather this information.

The source of solar wind and the possible applications a microgravity environment can provide for research in drug development and the changes which occur in muscles and bones in a weightless condition are some of the other areas to be investigated during the STS-56 mission.

The STS-56 crew will be commanded by Kenneth D. Cameron who will be making his second Shuttle flight. Stephen S. Oswald will serve as Pilot and will be making his second flight. Rounding out the ATLAS 2 crew will be three mission specialists - Michael Foale, making his second space flight and Kenneth D. Cockrell and Ellen Ochoa who will be making their first flight.

Launch of Discovery is currently targeted for late March from Kennedy Space Center's (KSC) Launch Complex 39-B. After launch, the STS-56 crew will work in two teams, each on 12 hour shifts, making observations and collecting data with the experiments and instruments being carried on the mission. The mission is scheduled to last 8 days and conclude with a landing at KSC's Shuttle Landing Facility.

ATLAS 2 is the primary payload for the STS-56 mission, the second in a series of missions which will track subtle, year-to-year variations in solar activity and in atmospheric composition. The ATLAS series is a vital part of NASA's "Mission to Planet Earth," a long-term effort to study the Earth as a global environmental system. The SSBUV experiment which is co-manifested with ATLAS 2, provides calibrated ozone data contributing to the Mission to Planet Earth data set.

The Space Shuttle is the ideal platform for NASA's remote-sensing atmospheric laboratory. The flight crew can maneuver the orbiter so the instruments in the bay point precisely toward the atmosphere, the sun or the Earth's surface as necessary for scheduled observations.

The Shuttle's generous payload capacity and power supply allow a diverse assembly of large instruments to make simultaneous remote observations. The Shuttle-borne ATLAS 2/SSBUV instruments make more detailed measurements than similar instruments now flying aboard satellites. France, Belgium and Germany are providing three of the ATLAS 2 instruments.

Also flying in Discovery's payload bay will be the Spartan-201, a free-flying payload to study the velocity and acceleration of the solar wind and to observe aspects of the sun's corona. Results should help scientists understand the physics of the sun's corona and the solar wind. When the Shuttle's payload bay doors are open, a crew member will use the Remote Manipulator System (RMS) to lift the Spartan from its rack and release it over the side of the Shuttle.

Spartan is deployed from the Shuttle so that Spartan can operate independently, turning and pointing at the sun, while leaving the orbiter free for other activities. After completing its observations, Spartan-201 will be retrieved using the RMS and will be stowed back in the cargo bay to be returned to Earth.

NASA's long standing educational outreach efforts will be highlighted in two STS-56 experiments - the Solar Ultraviolet Experiment (SUVE) and the Shuttle Amateur Radio Experiment (SAREX).

SUVE will be carried in a Get-Away-Special (GAS) canister in Discovery's cargo bay. The SUVE experiment will study the extreme ultraviolet solar radiation as it affects the Earth's ionosphere. SUVE was developed by students at the Colorado Space Grant Consortium, a group of 14 colleges and universities with funding from NASA. NASA's GAS program provides low-cost access to space for high school and college students as well as other small research groups.

The Shuttle Amateur Radio Experiment-II (SAREX-II) provides public participation in the space program, supports educational initiatives and demonstrates the effectiveness of making contact between the Space Shuttle and low-cost amateur "ham" radio stations on the ground. On STS-56, crew members Ken Cameron, Ken Cockrell, Mike Foale and Ellen Ochoa will use SAREX-II as a secondary payload. Operating times for school contacts are planned into the crew's activities. The school contacts generate interest in science as students talk directly with the astronauts.

Several experiments, previously flown on Shuttle missions, are aboard Discovery on the STS-56 mission.

The Hand-held, Earth-oriented, Real-time, Cooperative, User- friendly, Location-targeting and Environmental System (HERCULES) experiment, which flew on STS-53 in December 1992, again will test a system developed to allow a Shuttle astronaut in space to point a camera at an interesting feature on Earth, record the image and determine the latitude and longitude of the feature.

The Air Force Maui Optical Station (AMOS) experiment, which has been a part of numerous Shuttle missions, will fly on the STS-56 mission. The AMOS is an electro-optical facility located on the Hawaiian island of Maui. The facility tracks the orbiter as it flies over the area and records signatures from thruster firings, water dumps or the phenomenon of "shuttle glow."

Two other experiments which have flown before, Space Tissue Loss-3 and Physiological and Anatomical Rodent Experiment (PARE.03) will use different methods to address the issue -- why bones and muscles change when they experience a weightless condition.

The Radiation Monitoring Equipment-III (RME-III), flown on several missions, and the Cosmic Radiation Effects and Activation Monitor (CREAM), which last flew on STS-44 in November 1991, will be a part of the STS-56 mission. RME-III is an instrument which measures the exposure to ionizing radiation on the Space Shuttle. It displays the dose rate and total accumulated radiation dose to the astronaut operator. The CREAM experiment is designed to collect data on cosmic ray energy loss spectra, neutron fluxes and induced radioactivity. The data will be collected by active and passive monitors placed at specific locations throughout the orbiter's cabin.

The STS-56 mission will be the 16th flight of Space Shuttle Discovery and the 55th flight of the Space Shuttle.

- end -

MEDIA SERVICES

NASA Select Television Transmission

NASA Select television is available on Satcom F-2R, Transponder 13, located at 72 degrees west longitude; frequency 3960.0 MHz, audio 6.8 MHz.

The schedule for television transmissions from the orbiter and for the mission briefings will be available during the mission at Kennedy Space Center, Fla; Marshall Space Flight Center, Huntsville, Ala.; Ames-Dryden Flight Research Facility, Edwards, Calif.; Johnson Space Center, Houston and NASA Headquarters, Washington, D.C. The television schedule will be updated to reflect changes dictated by mission operations.

Television schedules also may be obtained by calling COMSTOR 713/483-5817. COMSTOR is a computer data base service requiring the use of a telephone modem. A voice update of the television schedule is updated daily at noon EST.

Status Reports

Status reports on countdown and launch, on-orbit activities and landing operations will be produced by the appropriate NASA newscenter.

Briefings

A mission press briefing schedule will be issued prior to launch. During the mission, mission status briefings by a flight director or mission operations representative and representatives from the science team will occur at least once per day. The updated NASA Select television schedule will indicate when mission briefings are planned.

STS-56 QUICK LOOK

Launch Date/Site:	Late March,1993/Kennedy Space Center - Pad 39B
Launch Time:	12:50 a.m. EST
Orbiter:	Discovery (OV-103) - 16th Flight
Orbit/Inclination:	160 nautical miles/57 degrees
Mission Duration:	8 days, 6 hours, 6 minutes
Landing Time/Date:	TBD
Primary Landing Site:	Kennedy Space Center, Fla.
Abort Landing Sites:	Return to Launch Site - KSC, Fla. TransAtlantic Abort landing - Zaragoza, Spain Ben Guerir, Morroco Moron, Spain Abort Once Around - White Sands, N.M.
Crew:	Kenneth D. Cameron, Commander (CDR) Stephen S. Oswald, Pilot (PLT) Michael C. Foale, Mission Specialist 1 (MS1) Kenneth D. Cockrell, Mission Specialist 2 (MS2) Ellen Ochoa., Mission Specialist 3 (MS3)
Blue Team:	Cameron, Oswald, Ochoa
Red Team:	Cockrell, Foale
Cargo Bay Payloads:	ATLAS 2 (Atmospheric Lab for Applications and Science-2) SSBUV-A (Shuttle Solar Backscatter Ultraviolet-A) SPARTAN-201 (Solar Wind Generation Experiment) SUVE (Solar Ultraviolet Experiment)
In-cabin Payloads:	CMIX (Commercial Materials Dispersion Apparatus) PARE (Physiological and Anatomical Rodent Experiment) HERCULES (Hand-held, Earth-oriented, Real-time, Cooperative, User-friendly, Location-targeting and Environmental System) SAREX-II (Shuttle Amateur Radio Experiment-II) STL (Space Tissue Loss) AMOS (Air Force Maui Optical System) CREAM (Cosmic Ray Effects and Activation Monitor) RME-III (Radiation Monitoring Equipment-III)

SPACE SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, orbiter and its payload. Abort modes include:

*Abort-To-Orbit (ATO) -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical mile orbit with orbital maneuvering system engines.

*Abort-Once-Around (AOA) -- Earlier main engine shutdown with the capability to allow one orbit around before landing at White Sands Space Harbor.

*Trans-Atlantic Abort Landing (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at either Zaragoza, Spain; Ben Guerir, Morocco; or Moron, Spain.

*Return-To-Launch-Site (RTLS) -- Early shutdown of one or more engines, without enough energy to reach Zaragoza, would result in a Shuttle pitch around and thrust back toward KSC until within gliding distance of the Shuttle Landing Facility.

STS-56 contingency landing sites are the Kennedy Space Center, White Sands Space Harbor, Zaragoza, Ben Guerir and Moron.

STS-56 SUMMARY TIMELINE

Blue/Red - Flight Day One
Ascent
OMS-2
Remote Manipulator System checkout
Remote Manipulator System payload bay survey
Shuttle Amateur Radio Experiment set-up
HERCULES set-up
RME activation
Shuttle Solar Backscatter Ultraviolet activation

Red - Flight Day Two
Atmospheric Laboratory for Applications and Science activation
Commercial Materials Dispersion activation
Solar Ultraviolet Experiment activation

Blue - Flight Day Two
ATLAS 2 operations
SUVE operations

Red - Flight Day Three
ATLAS 2 operations
SUVE operations
Laser range finder checkout
HERCULES operations

Blue - Flight Day Three
ATLAS 2 operations
SUVE operations

Red - Flight Day Four
ATLAS 2 operations
SUVE operations
SPARTAN-201 checkout

Blue - Flight Day Four
SPARTAN-201 deploy
Separation burns
ATLAS 2 operations

Red Flight Day Five
ATLAS 2 operations
SUVE operations

Blue Flight Day Five
SPARTAN-201 stationkeeping
ATLAS 2 operations
SUVE operations

Red - Flight Day Six
ATLAS 2 operations
SUVE operations

Blue - Flight Day Six
SPARTAN-201 rendezvous
SPARTAN-201 grapple
SPARTAN-201 berth

Red - Flight Day Seven
ATLAS 2 operations
SUVE operations

Blue - Flight Day Seven
Flight Control Systems checkout
ATLAS 2 operations
SUVE operations

Red - Flight Day Eight
Orbital Debris Radar Calibration System deploy
ATLAS 2 operations
HERCULES operations

Blue - Flight Day Eight
ATLAS 2 operations
SUVE operations
RMS power down and berth
RME deactivation
SAREX deactivation

Red/Blue - Flight Day Nine
ATLAS 2 deactivation
SSBUV deactivation
SUVE deactivation
Cabin stow
Deorbit preparations
Deorbit burn
Landing

STS-56 VEHICLE AND PAYLOAD WEIGHTS

Vehicle/Payload	Pounds
Orbiter (Discovery) empty and 3 SSMEs	173,227
ATLAS 2	8,360
SPARTAN-201 (deployable)	2,842
SPARTAN-201 (support equipment)	2,425
SSBUV	733
SUVE	593
CMIX	71
PARE	170
SAREX-II	67
RME-III	7
CREAM	37
HERCULES	126
STL	58
Total Vehicle at SRB Ignition	4,500,837
Orbiter Landing Weight	206,532

ATLAS 2

ATLAS 2, the second in NASA's series of Atmospheric Laboratory for Applications and Science Spacelab missions, is the primary payload for the STS-56 flight. The Space Shuttle-borne remote sensing laboratory studies the sun's energy output and Earth's middle-atmosphere chemical makeup, and how these factors affect levels of ozone, which prevents much of the sun's harmful ultraviolet radiation from reaching the Earth's surface.

Ozone depletion has been a serious environmental concern since the 1970s. In the mid-1980s, British scientists observed significant ozone depletion of the Antarctic. Visual images of the concentrated, well-defined areas of depletion gave rise to the term "ozone hole," which has appeared over the Antarctic since at least 1979. Satellite observations since then have shown long-term ozone depletion occurring in the Southern and Northern Hemispheres.

Concerns over the possible effects of ozone depletion, increases in cataracts and skin cancer and possible damage to food crops, led to an international treaty to phase out the use of ozone-depleting chemicals. However, many questions about the exact mechanisms of ozone depletion remain unanswered. To help answer those questions, the ATLAS missions will gather data on atmospheric chemistry and on the sun's energy - key ingredients in the ozone cycle.

Ozone is created and destroyed by complex reactions involving ultraviolet radiation from the sun and gases in the middle atmosphere, between 10 and 50 miles (15 and 80 kilometers) above the Earth's surface. ATLAS 1, which flew in March 1992, established a voluminous baseline of atmospheric and solar data against which to measure future global change.

ATLAS 2 and subsequent missions will track subtle, year-to-year variations in solar activity and in atmospheric composition. ATLAS instruments are precisely calibrated before and after flight, so they also provide a valuable cross-check for data being gathered on a continuous basis by similar instruments aboard free-flying satellites.

The ATLAS series is a vital part of NASA's "Mission to Planet Earth," a long-term effort to study the Earth as a global environmental system. Mission to Planet Earth will observe and monitor the interaction of large environmental components (land, oceans/water/ice, atmosphere and the biosphere). Data gathered will be distributed to global change researchers worldwide, allowing them to better understand natural changes in the Earth and to differentiate natural change from human-induced change. Mission to Planet Earth research will help humans make informed decisions about protecting their environment.

Scientists from six nations are participating directly in the ATLAS 2 mission, underscoring the worldwide importance of atmospheric and solar research. In addition to the United States, investigators represent Belgium, Germany, France, The Netherlands and Switzerland.

ATLAS 2 Instruments

The Space Shuttle Discovery will carry the ATLAS 2 Spacelab into orbit for 8 days of remote sensing experiments. Six instruments are mounted in the orbiter's payload bay on a Spacelab pallet. The seventh is mounted in two canisters on the walls of the payload bay.

The open, U-shaped pallet is reusable Spacelab equipment provided by the European Space Agency in 1981 as its contribution to the Space Shuttle program. The instruments' power supply, command and data-handling system and temperature control system are housed in a pressurized container called an igloo (also standard Spacelab equipment) located in front of the pallet. These seven instruments form the core ATLAS payload which will fly aboard ATLAS 2 as well as ATLAS 3 scheduled for late 1994.

Atmospheric Science

- The Atmospheric Trace Molecule Spectroscopy (ATMOS) experiment identifies the distribution, by altitude, of 30 to 40 different gases between 6 and 85 miles (10 and 140 kilometers) above the Earth's surface.

- The Millimeter Wave Atmospheric Sounder (MAS) measures water vapor, ozone and chlorine monoxide (a key compound that contributes to ozone loss), as well as temperature and pressure in the middle atmosphere.

- The Shuttle Solar Backscatter Ultraviolet (SSBUV) spectrometer, mounted on the walls of the payload bay, measures ozone concentrations by comparing solar ultraviolet radiation with that scattered back from the Earth's atmosphere.

Solar Science

- The Solar Spectrum Measurement (SOLSPEC) instrument studies the distribution of solar energy by wavelength, from infrared through ultraviolet.

- The Solar Ultraviolet Irradiance Monitor (SUSIM) concentrates on the sun's ultraviolet radiation, which undergoes wider variations than other wavelengths.

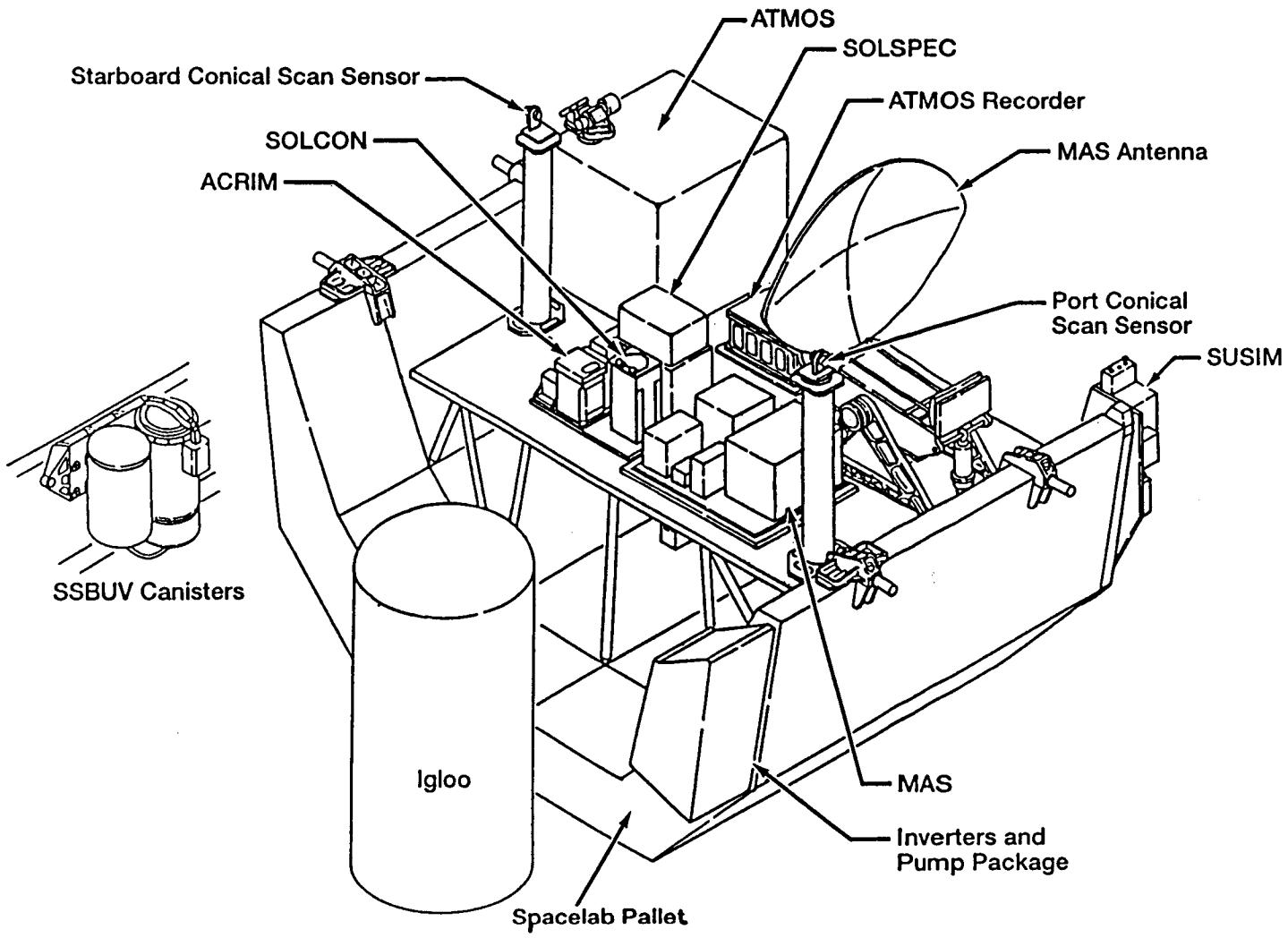
- The Active Cavity Radiometer (ACR) and the Solar Constant (SOLCON) experiments each make extremely precise, independent measurements of the total energy Earth receives from the sun.

The steep, 57-degree Shuttle's orbit inclination will take it over points as far north as Juneau, Alaska, and as far south as Tierra del Fuego, Argentina -- allowing readings to be made over virtually the entire globe.

On ATLAS 2, the Atmospheric Trace Molecule Spectroscopy experiment, which made most of its measurements in the Southern Hemisphere during ATLAS 1, will focus on the Northern Hemisphere. To view orbital "sunrises" at high latitudes, a night launch is required.

ATLAS 2 Investigations

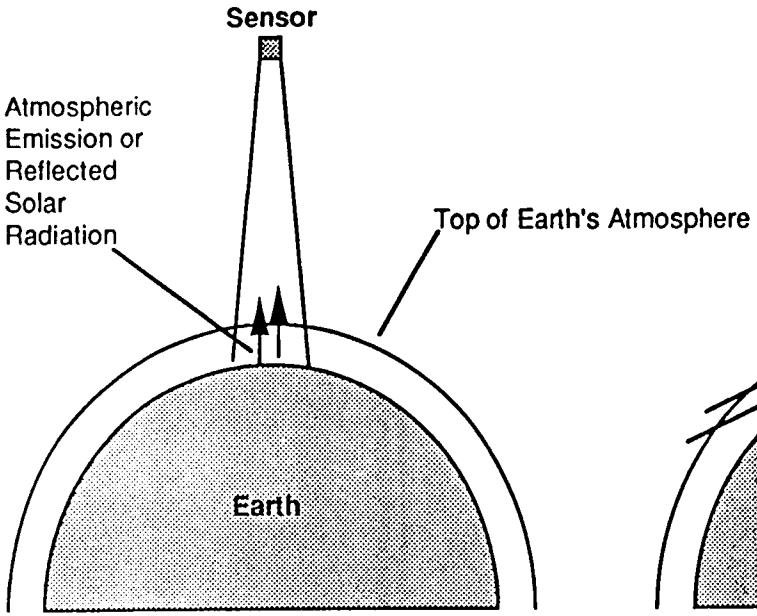
Investigation	Spectral Range	Selected Objectives	Principal Investigator
Atmospheric Science:			
ATMOS	Infrared	Water vapor, ozone, methane, chlorine and nitrogen compounds, chlorofluorocarbons, others	M. Gunson, NASA Jet Propulsion Laboratory, United States
MAS	Microwave	Temperature, pressure, ozone, chlorine monoxide, water vapor	G. Hartmann, Max Plank Institute for Aeronomy, Germany
SSBUV	Near Ultraviolet	Ozone	E. Hilsenrath, NASA Goddard Spac Flight Center, United States
Solar Science:			
ACRIM	Total Energy	Solar constant	R. Willson, NASA Jet Propulsion Laboratory, United States
SOLCON	Total Energy	Solar constant	D. Crommelynck, Belgian Royal Institute for Meteorology, Belgi
SOLSPEC	Infrared to Ultraviolet	Solar spectrum	G. Thuillier, Aeronomy Service f the National Center for Scientif Research, France
SUSIM	Ultraviolet	Solar spectrum	G. Brueckner, Naval Research Laboratory, United States



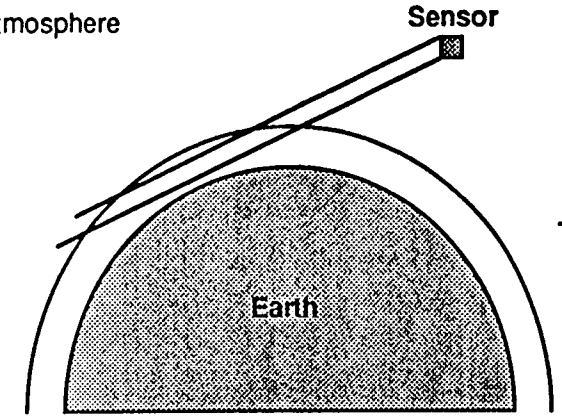
ATLAS 2 in Cargo Bay

Space Remote Sounding Techniques

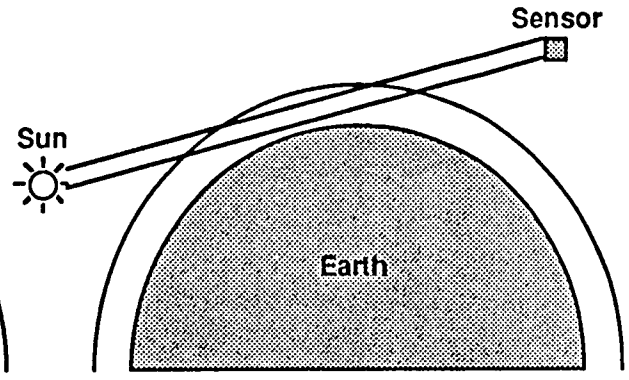
Nadir Sounding (SSBUV)

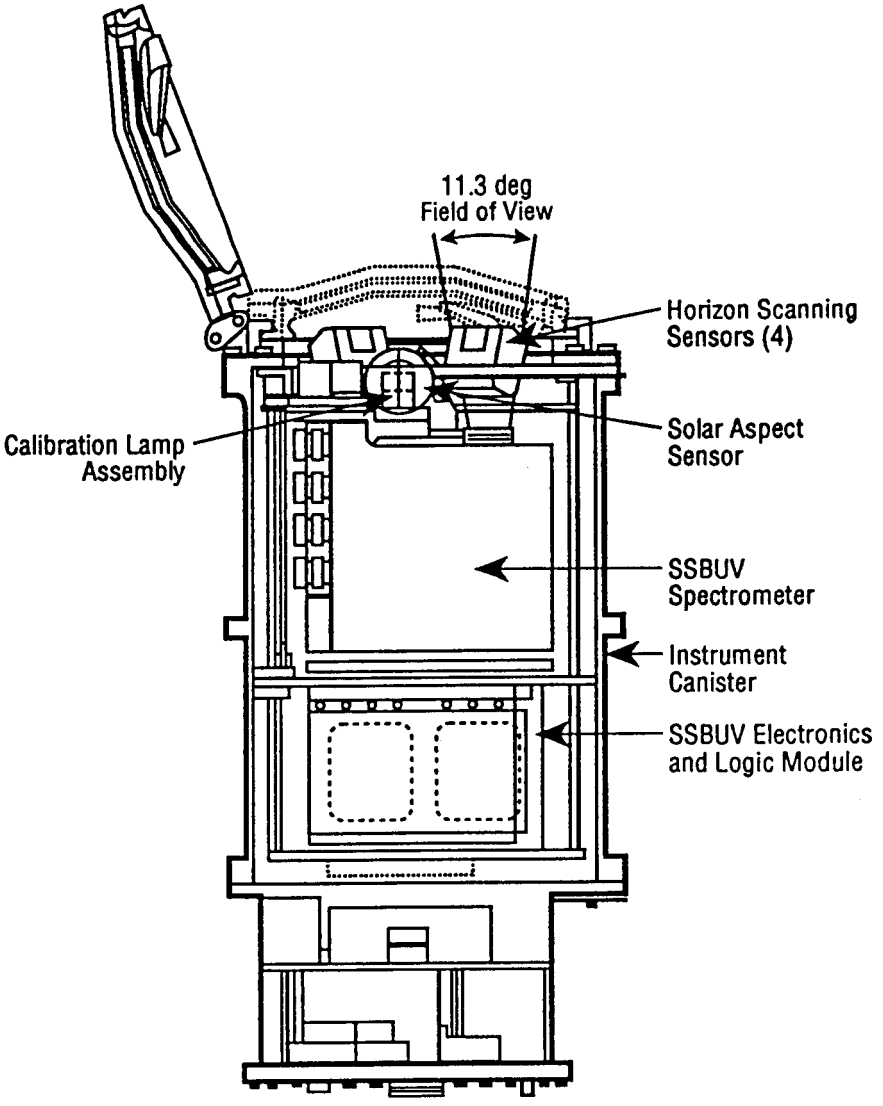


Atmospheric Limb Sounding (MAS)

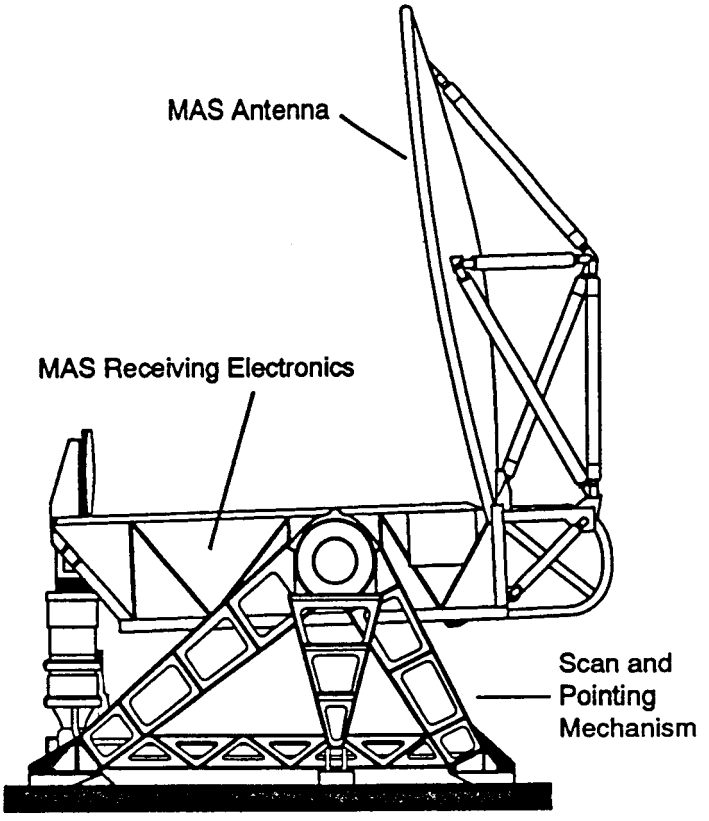


Solar Occulation (ATMOS)

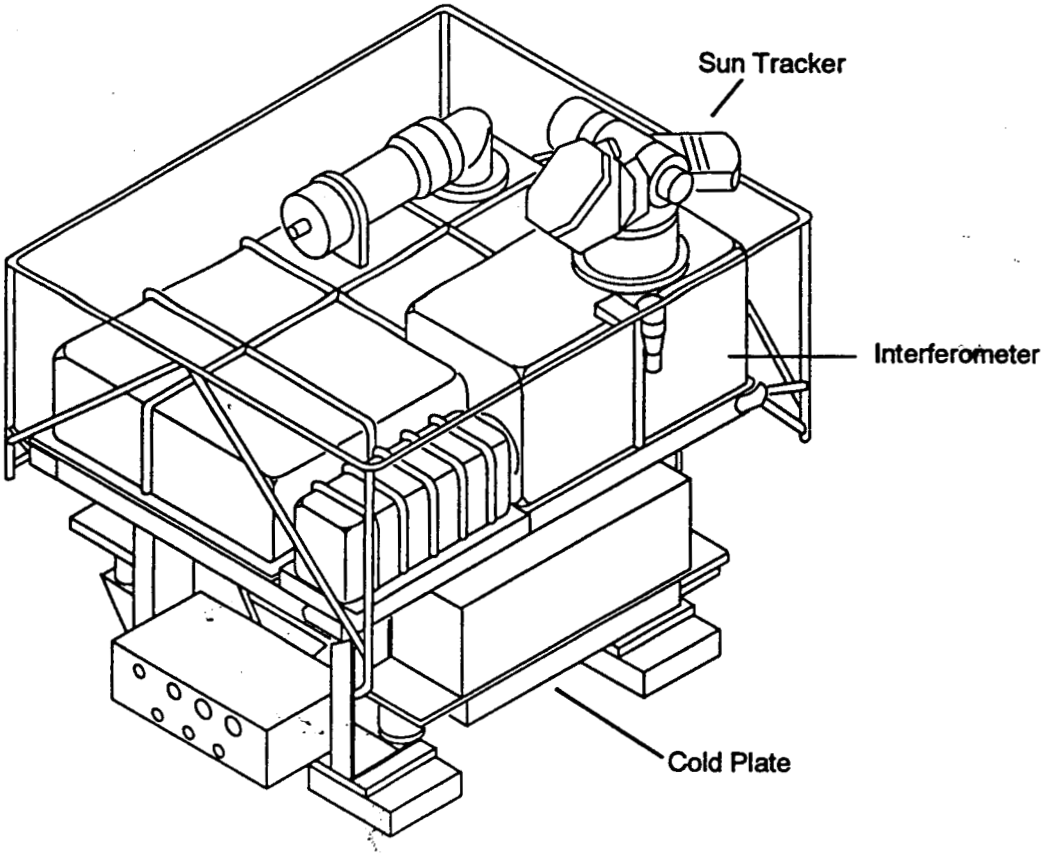



11.3 deg
Field of View
Horizon Scanning
Sensors (4)
Solar Aspect
Sensor
Calibration Lamp
Assembly
SSBUV
Spectrometer
Instrument
Canister
SSBUV Electronics
and Logic Module

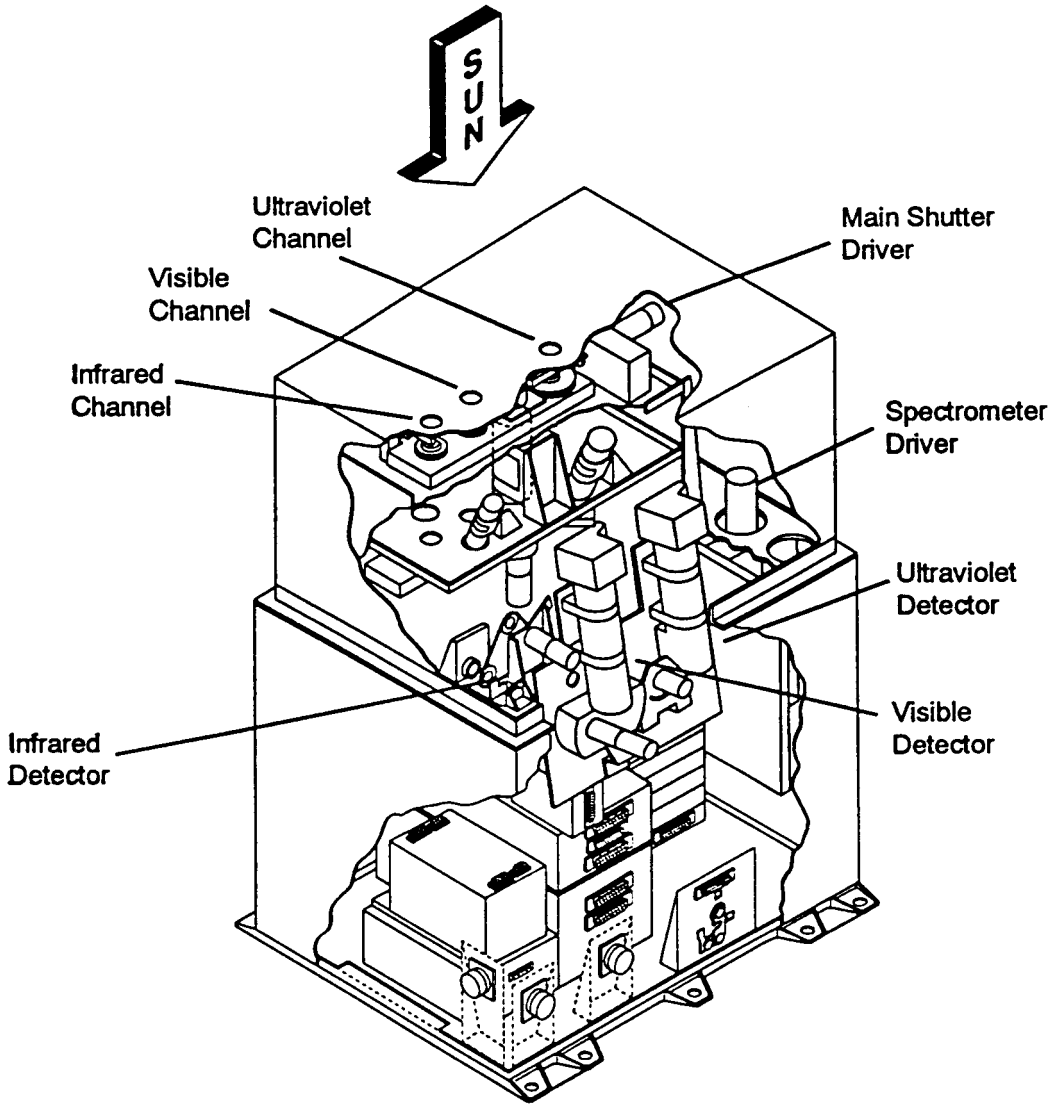
SSBUV



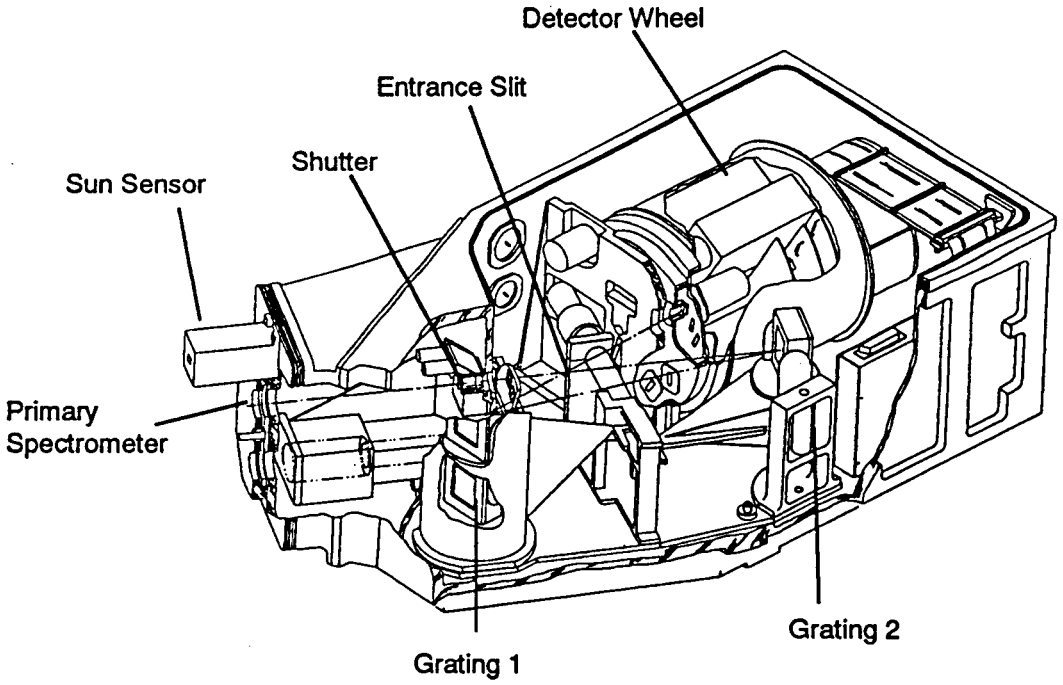
Millimeter-Wave Atmospheric Sounder (MAS)



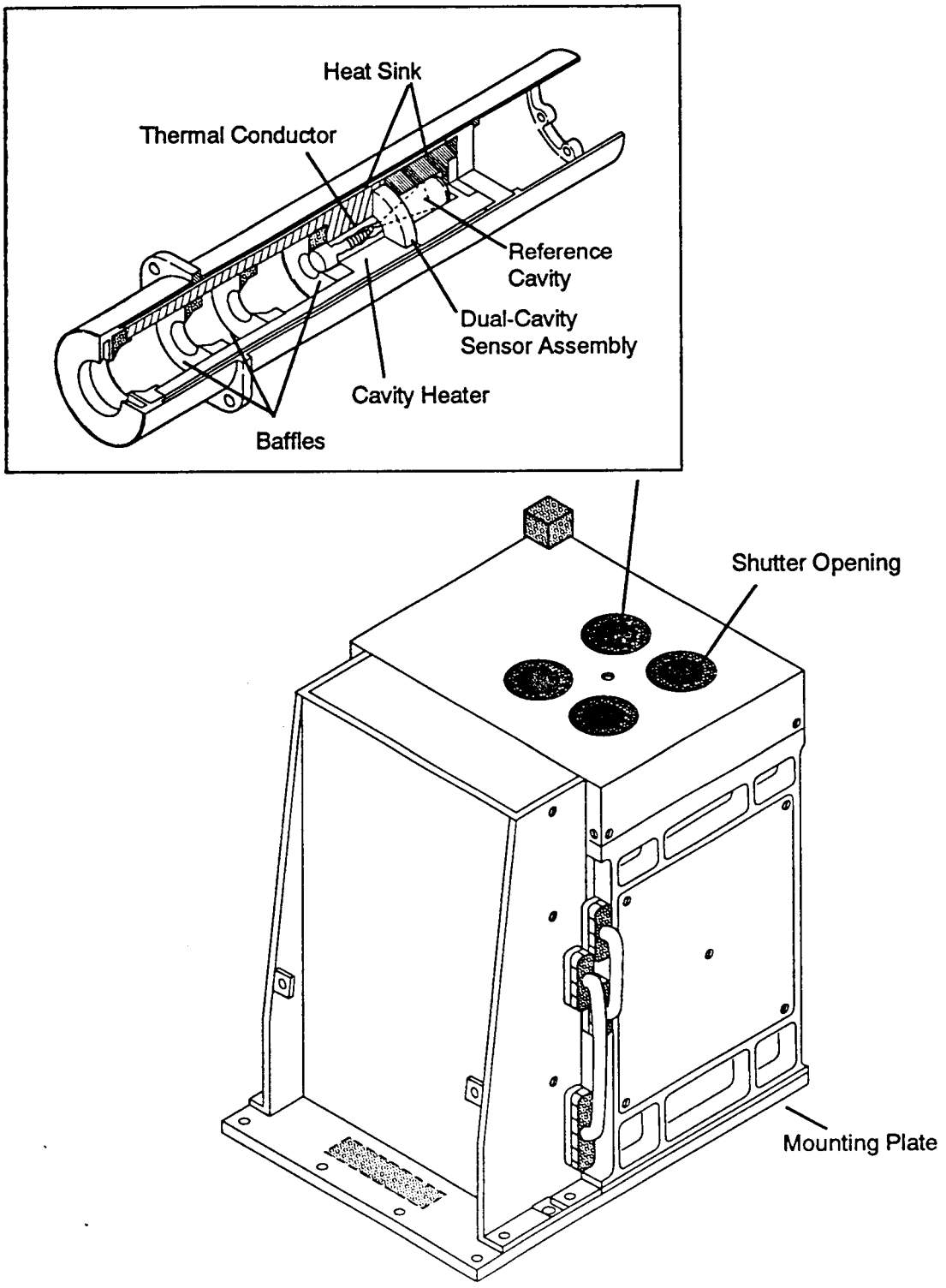
Atmospheric Trace Molecule Spectroscopy (ATMOS)



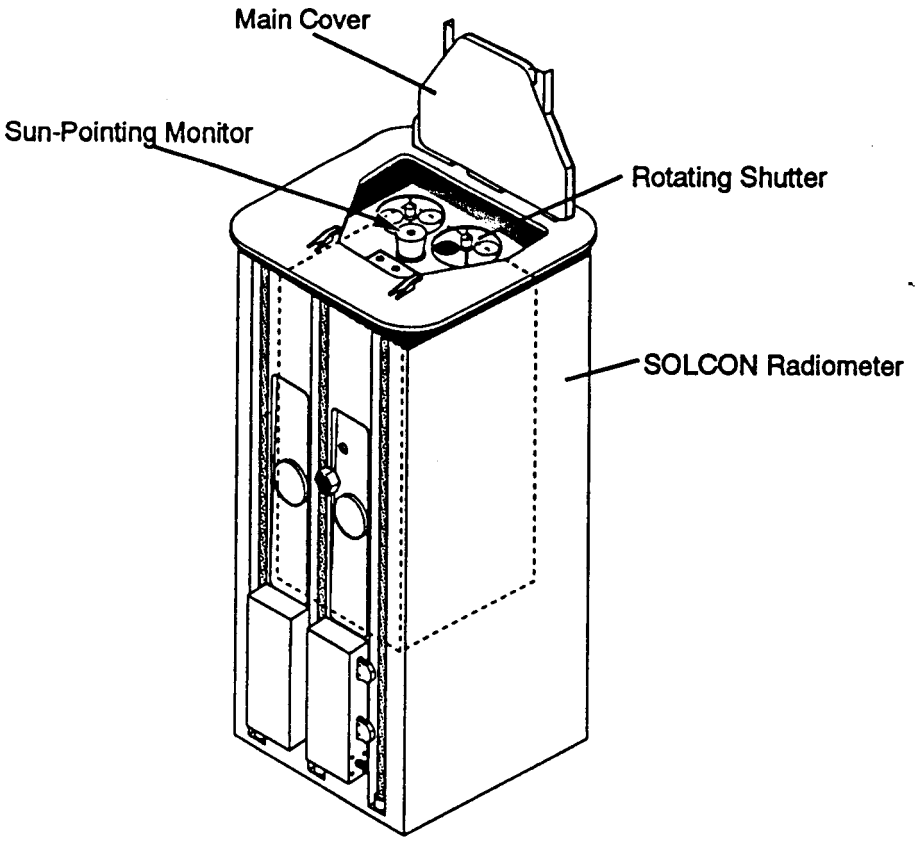
Solar Spectrum Measurement (SOLSPEC)



Solar Ultraviolet Irradiance Monitor (SUSIM)



Active Cavity Radiometer Irradiance Monitor (ACRIM)



Measurement of the Solar Constant (SOLCON)

ATLAS Missions and the Shuttle

The Space Shuttle is the ideal platform for NASA's remote-sensing atmospheric laboratory. The flight crew can maneuver the orbiter so the instruments in the bay point precisely toward the atmosphere, the sun or the Earth's surface as necessary for scheduled observations. The Shuttle's generous payload capacity and power supply allow a diverse assembly of large instruments to make simultaneous remote observations. The Shuttle-borne ATLAS instruments make more detailed measurements than similar instruments now flying aboard satellites.

Because the Shuttle returns the laboratory to Earth after each flight, it also has the advantage of assured calibration. ATLAS instruments are calibrated to a high level of accuracy prior to launch and shortly after the Shuttle lands, they are recalibrated to ensure their sensitive measurements remain accurate.

ATLAS missions take a "snapshot" of the atmosphere for about a week at a time. However, atmospheric and solar measurements are being made continuously by instruments aboard free-flying satellites, such as the Upper Atmosphere Research Satellite launched in September 1991 and various National Oceanic and Atmospheric Administration (NOAA) satellites.

Extended exposure to the harsh environment of space, especially to ultraviolet radiation, can degrade the accuracy of those instruments. By comparing data from the ATLAS instruments to their sister experiments aboard the free-flyers, scientists can correct for drift in the satellite instruments and have a high level of confidence in the accuracy of their measurements.

Science Operations Plan

The ATLAS 2 science operations plan calls for periods of atmospheric data gathering interspersed with orbits dedicated to solar observations.

During their designated orbits, the instruments investigating middle atmospheric phenomena will operate almost continuously. ATMOS will take solar radiation absorption readings during each orbital sunrise and sunset. (An orbital "day," with a sunrise and sunset, occurs approximately every 90 minutes during flight.)

MAS will measure microwave emissions from Earth's limb throughout each orbit, and SSBUV will make its measurements of backscattered ultraviolet radiation in the daylight portion of these orbits. The ATMOS and MAS instruments will be inactive during solar observation periods.

Solar observations are scheduled early in the flight, on two occasions in the middle of the mission and during the last full day of science operations. At these times, ACRIM and SOLCON will measure total solar irradiance. SUSIM and SOLSPEC will make solar spectral measurements, and SSBUV will gather its data on solar ultraviolet radiation.

The Shuttle orbit allows numerous correlative measurements with UARS and the NOAA satellites. Similar instruments aboard these spacecraft will make independent measurements of the same regions of the atmosphere at about the same time. Data gathered during these opportunities will be compared to check the accuracy of readings by the satellite instruments.

The ATLAS experiments will gather data from about 4 hours after launch until approximately 12 hours before landing. ATLAS operations will be suspended temporarily during deployment and retrieval of the Shuttle Pointed Autonomous Research Tool for Astronomy (SPARTAN) free flyer, since Shuttle maneuvers required for those activities will prevent proper pointing of the ATLAS instruments.

The ATLAS 2 Team

The ATLAS program is sponsored by NASA's Office of Space Science and Applications and is directed by the Earth Science and Applications Division and the Flight Systems Division, located in Washington, D.C.

The mission management and control of each ATLAS flight is the responsibility of NASA's Marshall Space Flight Center, Huntsville, Ala. The mission manager directs a civil service and contractor team effort to match science objectives with Shuttle-Spacelab resources so each flight is fine-tuned to gather the maximum amount of science information. This effort includes preparing a minute-by-minute schedule, called a timeline, that combines crew activities, experiment requirements, Spacelab resources and Shuttle maneuvers into an efficient operating plan.

Principal investigators of the individual experiments form an Investigator Working Group that meets regularly before the mission to advise the mission manager's team on science-related issues and payload operations. The working group is chaired by the mission scientist, a member of the mission manager's team.

During the mission, the management and science teams control the ATLAS instruments around the clock from NASA's Spacelab Mission Operations Control facility at the Marshall center. The facility contains banks of computers, monitors and communication consoles which enable the ground team to monitor the payload, collect data, send direct commands to the experiments and communicate with the Shuttle crew. During the mission the science teams meet twice daily as a Science Operations Planning Group to evaluate science activities, solve problems and recommend ways to take full advantage of any unplanned opportunities.

The two European solar experiments, SOLCON and SOLSPEC, will be jointly operated from the NASA control center in Huntsville and from a control center at the Institut Royal Meteorologique de Belgique, Brussels, Belgium, during portions of the ATLAS 2 mission.

Most of the ATLAS instruments operate automatically, commanded by the Spacelab computers or by the science teams in Huntsville. However, crew members can use keyboards to enter observation sequences or commands if necessary. Another crew member on each team is part of the orbiter crew and is responsible for maneuvering the Shuttle when an instrument requires precise pointing or must be operated in a specific attitude.

SHUTTLE POINT AUTONOMOUS RESEARCH TOOL FOR ASTRONOMY-201 (SPARTAN-201)

Spartan-201 is a free-flying payload that will study the velocity and acceleration of the solar wind and observe aspects of the sun's corona. Results will help scientists understand the physics of the sun's corona and the solar wind.

Spartan is deployed by the Shuttle and retrieved on the same mission. While overboard it is completely autonomous, providing its own battery power, pointing system and data recorder as it executes a pre-programmed science mission. The Spartan carrier can support a variety of scientific studies and serve as a test bed for technology development.

The Space Shuttle offers easy access to a variety of systems that can conduct scientific investigations from above the Earth's atmosphere. Spartan is one of those systems, providing a capability between small attached payloads and the large, long duration, free-flying satellites.

Spartan has evolved using sounding rocket class instruments to perform the scientific studies. This system provides a significant increase in observing time compared to sounding rockets. The simple and efficient Spartan carriers are reusable and can accommodate a variety of scientific instruments for a relatively low cost-per-flight.

Spartan-201 Science

Spartan-201 will look for evidence to explain how the solar wind is generated by the sun. Electrons, heavy protons and heavy ions are constantly ejected from the outer layers of the solar atmosphere. The Earth encounters this material continually as it orbits the sun. The solar wind fills interplanetary space and sweeps by the Earth at almost 1 million miles per hour (400 km/sec). It often blows in gusts and frequently disrupts navigation, communications and electric power distribution systems on Earth.

The solar wind originates in the corona, the outermost atmosphere of the sun. Two telescopes for studying the corona comprise the science payload of Spartan 201. One telescope, the White Light Coronagraph (WLC), will measure the density distribution of electrons making up the corona. The other telescope, the Ultraviolet Coronal Spectrometer (UVCS), will investigate the temperatures and distributions of protons and hydrogen atoms through the same layers of the corona. Ultraviolet radiation, which is absorbed by the Earth's atmosphere, cannot be observed from the ground.

A comparison of the white light and ultraviolet data sets will, for the first time, allow scientists to measure the electron and proton temperatures and densities in the solar corona This also will yield new evidence on large flows of material in the corona and allow scientists to test specific theories on how the corona is heated to its million-degree temperature.

The UVCS was built by scientists from the Smithsonian Astrophysical Observatory, Harvard University, Cambridge, Mass. The WLC was developed by the High Altitude Observatory of the National Center for Atmospheric Research in Boulder, Colo., and has been transferred to NASA's Goddard Space Flight Center (GSFC), Greenbelt, Md.

Deployment

The dual-telescope payload is mounted on the Spartan carrier. On orbit, a crew member will use the Remote Manipulator System to lift the Spartan from its rack and release it over the side of the Shuttle. Spartan will operate independently, turning and pointing at the sun, leaving the orbiter free for other activities. Additionally, by maintaining its distance from the Shuttle, the Spartan is able to stay clear of any contamination which might be generated by Shuttle thruster firings.

Spartan-201 will be deployed on the third day of STS-56. Discovery will perform a series of engine firings that will put Discovery at a point about 20 nautical miles (37 km) behind the satellite.

For between 6 and 40 hours, Spartan-201's instruments will observe the sun. At about 4 hours prior to the scheduled retrieval time, Discovery will close on Spartan-201, eventually passing directly below it before Commander Steve Oswald manually flies Discovery the final few hundred feet to allow the satellite to be grasped by the robot arm. Once caught by the arm, Spartan-201 will be stowed back in the cargo bay to be returned to Earth.

Spartan is designed to be self-operating as much as possible, and the crew will have no interaction with the satellite other than releasing it and recapturing it.

History

The Spartan Program was conceived in the mid-1970s and developed by GSFC and the U.S. Naval Research Laboratory to extend the capabilities of sounding rocket class science experiments by making use of the Space Shuttle.

The telescopes on Spartan-201 have flown previously on sounding rockets. In June 1985, a Spartan mission carried an x-ray telescope. Another mission, Spartan Halley, was on board STS-51L and was destroyed in the Challenger accident.

The Spartan program is managed by GSFC for the Office of Space Science and Applications, Washington, D.C. The Spartan Project Manager is Frank Collins and the Mission Manager is Jack Pownell, both of Goddard's Special Payloads Division. The Principal Investigator is Dick Fisher, also of GSFC.

SOLAR ULTRAVIOLET EXPERIMENT (SUVE)

SUVE is a Colorado Space Grant Consortium project that will study the extreme ultraviolet solar radiation as it affects the Earth's ionosphere. The payload is housed in a single Get-Away Special (GAS) canister, developed by NASA's Goddard Space Flight Center to provide low-cost access to space for high school and college students as well as other small research groups.

The SUVE payload is designed, managed and built entirely by students at the University of Colorado. Graduate and undergraduate students from aerospace, mechanical and electrical engineering as well as physics and other scientific disciplines have been involved since the project's inception. From project management to detailed performance analyses, the SUVE project is entirely student run.

The Colorado Space Grant Consortium is a group of 14 Colorado colleges and universities funded by NASA for the express purpose of educating students in the science and engineering aspects of exploring and working in outer space. The programs range from introductory education for K-12 students, to design and development of actual space projects for undergraduate and graduate students.

STS-56 EDUCATION ACTIVITIES

Atmospheric Detectives, ATLAS 2 Teacher's Guide

A teacher's guide entitled, *Atmospheric Detectives*, has been developed for use with middle school students to complement and teach the science objectives of the ATLAS 2 mission.

Atmospheric Detectives blends lessons in mathematics, chemistry, physics and Earth sciences with problem solving exercises in an attempt to nurture students' natural curiosity and excitement about science and technology. The ATLAS 2 teacher's guide probes the connection between the activities of scientists and researchers and the observable world of weather and climate.

Students briefly will examine the findings of the ATLAS-1 flight linking that mission with the science goals of ATLAS 2 and future flights. As scientists, students will explore how solar and atmospheric changes might affect climate, specifically looking at solar output, wind patterns and water vapor.

Students will explore how ATLAS 2 investigators measure the effects on climate using remote-sensing techniques of spectrometry and limb sounding as well as ground truth studies and exercises emphasizing the importance of mathematics and precise measurement.

HAND-HELD, EARTH-ORIENTED, REAL-TIME, COOPERATIVE, USER-FRIENDLY, LOCATION-TARGETING AND ENVIRONMENTAL SYSTEM (HERCULES)

Naval Research Laboratory (NRL) scientists will again test a system developed to allow a Shuttle astronaut in space to point a camera at an interesting feature on Earth, record the image and determine the latitude and longitude of the feature.

Called HERCULES, the system includes a modified Nikon camera and a geolocation device which determines in real-time the latitude and longitude of Earth images.

HERCULES will provide a valuable Earth observation system for military, environmental, oceanographic and meteorological applications. HERCULES, flown once before in December 1992 on Space Shuttle flight STS-53, is being integrated and flown on the Space Shuttle under the direction of the Department of Defense's Space Test Program.

Images and geolocation data taken during the STS-53 mission still are being analyzed, but geolocation accuracies are about 3 nautical miles. An additional system feature that will be used during STS-56 is the ability to transmit images and geolocation data to the Mission Control Center for analysis while the mission is in progress.

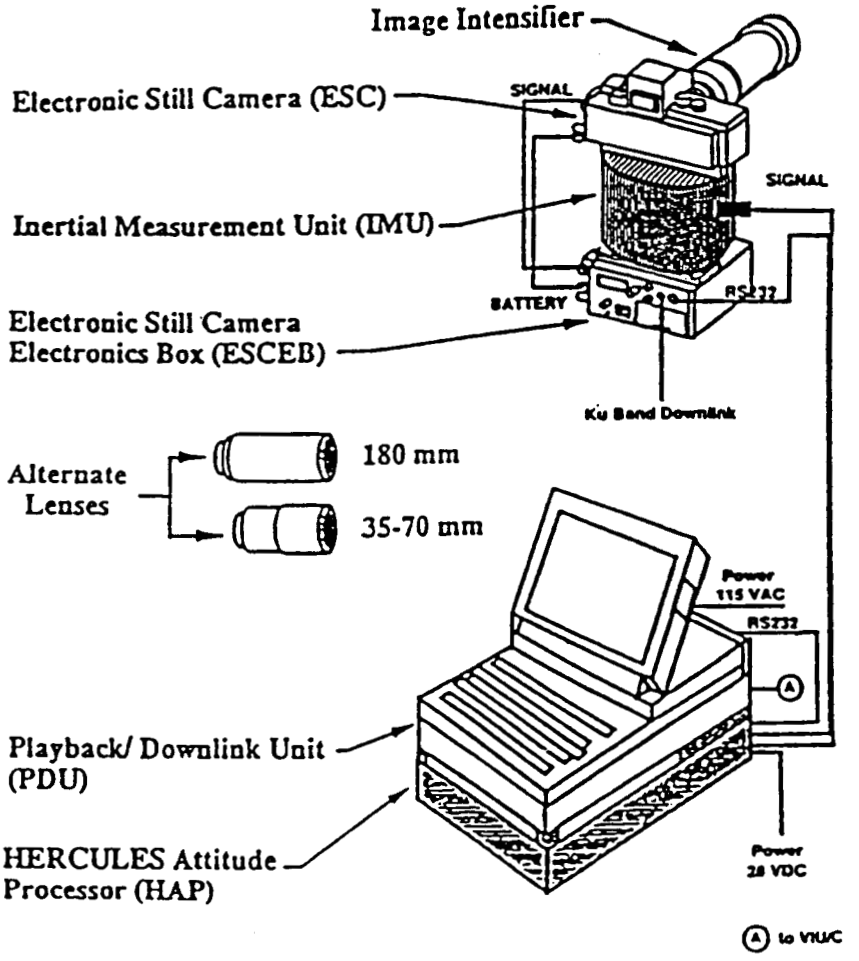
The project is a joint Navy, Army, NASA effort. Scientists at NRL's Naval Center for Space Technology developed the HERCULES Attitude Processor (HAP) and the alignment, geolocation and human interface software to perform the geolocation. The other components in the system are a NASA-built Electronic Still Camera (ESC) that stores images in a digital form and a modified Nikon F-4 and Honeywell ring-laser gyro.

On board the Shuttle, the astronaut will start up the system by pointing the camera, with the attached gyro, at two known stars to obtain a bearing. The astronaut then "shoots" images by pointing the camera at the Earth and snapping the shutter.

The camera communicates with HAP, which processes the data from the gyro and determines its absolute orientation in space. Then, the HAP passes this pointing information to the NRL software running on a NASA-modified GRID portable computer. The computer then determines the longitude and latitude of the image.

The geolocation information is sent back to the camera by the HAP, where it is appended to the image data. The astronaut can view the image on the Shuttle and downlink it to Earth. The image and geolocation data are also stored in the ESC system for post-mission analysis."

HERCULES



HERCULES Configuration B

The system is a significant improvement over its predecessor called L-cubed. Under the L-cubed system, the astronauts had to take multiple images of the same target while simultaneously keeping the edge of the Earth in view, which limited image magnification.

With HERCULES, the astronaut only needs to look at the point of interest, allowing the use of many different camera lenses. In the daytime, the system uses any Nikon-compatible lens. At night, it operates with an image intensifier developed by the Army's Night Vision Laboratory. At any magnification, images with no distinguishing demographical features can be captured and geolocated. HERCULES captures images digitally, which allows computer analysis and data dissemination, an improvement over the film-based L-cubed system.

NRL scientists already are exploring enhancements to HERCULES. Incorporating Global Positioning System (GPS) hardware into HERCULES would provide a geolocation accuracy better than 1 nautical mile, and adding a gimbal system would allow the system to automatically track points on Earth. One modification to HERCULES being considered is providing orbiter power to the ESC components rather than using the battery packs utilized on STS-53. By not having to replace the battery packs, the astronaut will have more opportunities to test the system.

RADIATION MONITORING EQUIPMENT-III (RME-III)

The RME-III instrument measures the exposure of ionizing radiation on the Space Shuttle. RME-III displays the dose rate and total accumulated radiation dose to the astronaut operator. Simultaneously RME-III registers the number of radiation interactions and dose accumulated at 10 second intervals and stores the data in an internal memory for follow-up analysis upon return to Earth.

The radiation detector used in RME-III is a spatial ionization chamber called a tissue equivalent proportional counter (TEPC). It effectively simulates a target size of a few microns of tissue, the dimensions of a typical human cell. For this reason, TEPC-based instruments such as the RME-III are called micro-dosimeter instruments.

RME stands for Radiation Monitoring Equipment, the name given to prototype dosimeter instruments flown on the Space Shuttle prior to 1986. The RME-III has successfully flown on 13 Space Shuttle missions since STS-26.

RME is being integrated and flown on this mission under the direction of the Defense Department's Space Test Program. It has been flown in conjunction with other radiation experiments, such as the Cosmic Radiation Effects and Activation Monitor and Shuttle Activation Monitor. It is anticipated that RME will be flown on several future Space Shuttle missions.

The data obtained from RME-III is archived and is being used to update and refine models of the space radiation environment in low Earth orbit. This will assist space mission planners to more accurately assess risk and safety factors in future long-term space missions, such as Space Station Freedom.

Next generation instruments similar to the RME-III will be flown on Space Station Freedom and on future manned and unmanned missions to the Moon, Mars and beyond. RME-III also is being used to measure radiation exposure in high altitude aircraft, such as the Concorde.

COSMIC RADIATION EFFECTS AND ACTIVATION MONITOR (CREAM)

The Cosmic Radiation Effects and Activation Monitor (CREAM) experiment on STS-56 is designed to collect data on cosmic ray energy loss spectra, neutron fluxes and induced radioactivity. The data will be collected by active and passive monitors placed at specific locations throughout the orbiter's cabin.

The active monitor will obtain real-time spectral data while the passive monitors will obtain data during the entire mission to be analyzed after the flight. The flight hardware contains the active cosmic ray monitor, a passive sodium iodide detector and up to five passive detector packages. All hardware fits in one locker on Discovery's middeck.

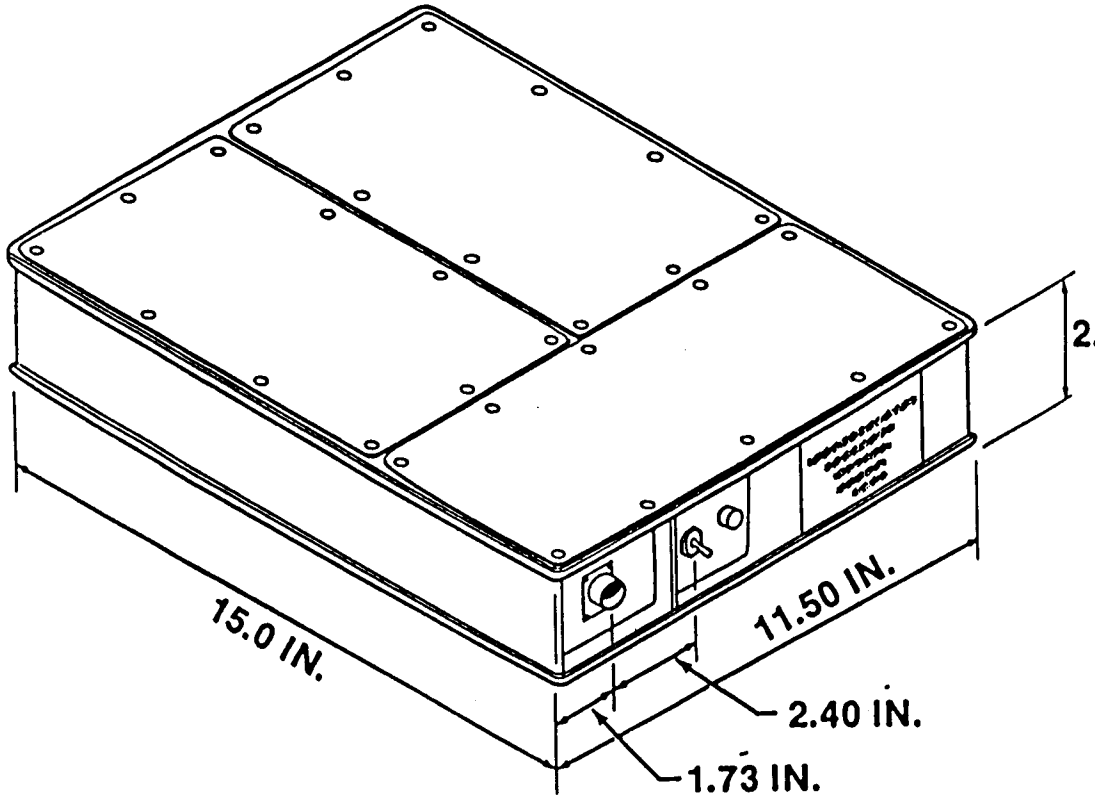
Once in orbit, a crew member will be available at regular intervals to monitor the payload/experiment. CREAM is a Department of Defense experiment and is flown under the direction of DoD's Space Test Program.

AIR FORCE MAUI OPTICAL SITE (AMOS)

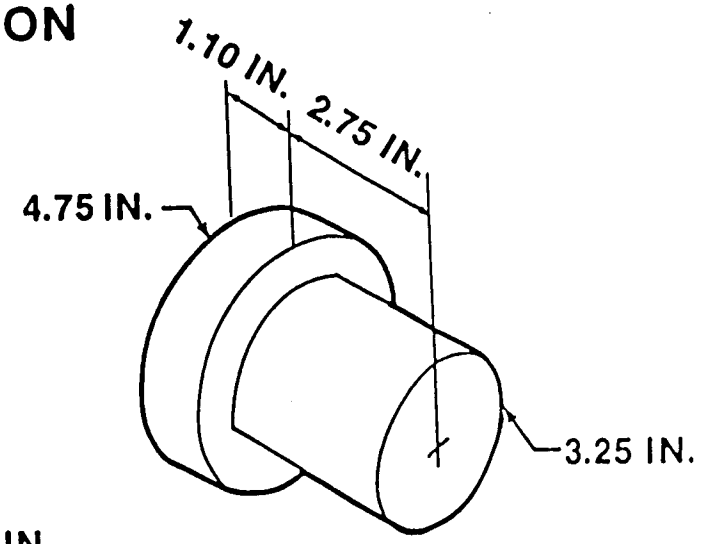
The AMOS is an electro-optical facility located on the Hawaiian island of Maui. The facility tracks the orbiter as it flies over the area and records signatures from thruster firings, water dumps or the phenomenon of "shuttle glow."

The Shuttle glow phenomenon around the orbiter is a well-documented glowing effect caused by the interaction of atomic oxygen with the spacecraft. The information obtained is used to calibrate the infrared and optical sensors at the facility. No hardware onboard the Shuttle is needed for this experiment.

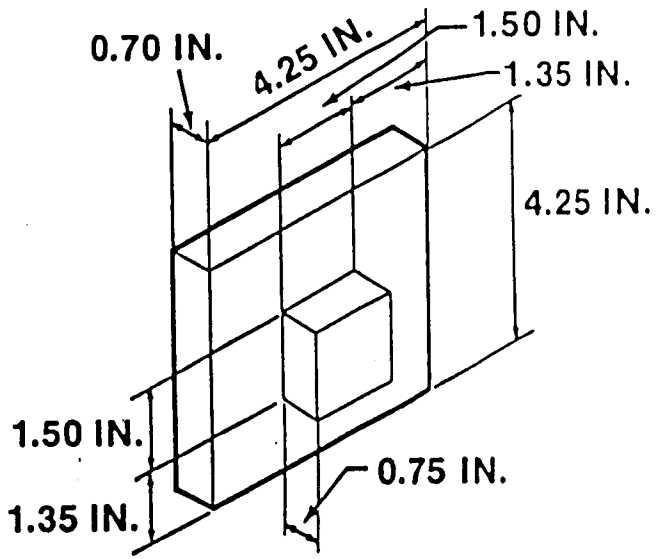
CREAM CONFIGURATION



ACTIVE MONITOR



SODIUM IODIDE CRYSTAL
PASSIVE DETECTOR



PASSIVE DOSIMETERY PACKAGE

SHUTTLE AMATEUR RADIO EXPERIMENT-II

The Shuttle Amateur Radio Experiment-II (SAREX-II) provides public participation in the space program, supports educational initiatives and demonstrates the effectiveness of making contact between the Space Shuttle and amateur "ham" radio stations on the ground.

SAREX-II was last flown aboard STS-55 and during that flight, there were dozens of voice contacts with ham stations at schools around the world and hundreds of contacts with individual ham operators. On STS-56, crew members Ken Cameron, call sign N5AWP, Ken Cockrell, call sign KB5UAH, Mike Foale, call sign KB5UAC, and Ellen Ochoa, call sign KB5TZZ, will use SAREX-II as a secondary payload.

Operating times for school contacts are planned into the crew's activities. The school contacts generate interest in science as students talk directly with the astronauts. There will be voice contacts with the general ham community as time permits. Shortwave listeners worldwide also may listen in. When the crew is not available, SAREX-II will be in an automated digital response mode.

SAREX-II will include VHF FM voice, VHF packet, VHF slow scan television and UHF fast scan television. The Space Shuttle has the built-in ability to downlink television on any mission, but only SAREX-II has the ability to uplink television to the crew. During STS-50, fast scan television uplink was used to send home videos of the crew members' families to the spacecraft, a specially recorded message from Jay Leno and a specially recorded Houston television sportscast.

The primary voice and packet frequencies that SAREX-II uses are 145.55 MHz downlink and 144.95 MHz uplink. The 600 KHz spacing in the transmit and receive frequency pair is compatible with amateur VHF equipment. Since STS-56 is a high inclination flight, SAREX-II may be heard from northern Canada to southern Australia and all points in between when the Shuttle is crossing overhead.

SAREX has previously flown on STS-9, STS-51F, STS-35, STS-37, STS-45, STS-50, STS-47 and STS-55. SAREX is a joint effort of NASA, the American Radio Relay League (ARRL), the Amateur Radio Satellite Corp. (AMSAT), and the Johnson Space Center's Amateur Radio Club. Information about orbital elements, contact times, frequencies and crew operating schedules will be made available during the mission by these agencies and by amateur radio clubs at some other NASA centers.

Hams from the Johnson Space Center club, W5RRR, will be operating on amateur shortwave frequencies, and the ARRL station, W1AW, will include SAREX information in its regular voice and teletype bulletins. The amateur radio station at the Goddard Space Flight Center, WA3NAN, in Greenbelt, Md., will operate around the clock during the mission, providing information and re-transmitting live Shuttle air-to-ground audio.

The Johnson Space Center Public Affairs Office man a SAREX information desk during the mission, and mission information also will be available on the dial-up computer bulletin board (BBS) at JSC.

SAREX Frequencies

	Shuttle Transmitting Frequency	Shuttle Receiving Frequency
U.S., Africa,	145.55 MHz	144.95 MHz
South America,	145.55	144.97
& Asia	145.55	144.91
Europe	145.55 MHz	144.95 MHz
	145.55	144.75
	145.55	144.70

GSFC Amateur Radio Club (WA3NAN) planned HF operating frequencies

3.860 MHz 7.185 MHz
14.295 Mhz 21.395 MHz
28.395 Mhz

To connect to the JSC Computer Bulletin Board, BBS, (8 N 1 1200 baud): dial 713/483-2500 then type 62511.

COMMERCIAL MDA ITA EXPERIMENTS

More than 30 investigations will be conducted aboard Space Shuttle Discovery to obtain information on how microgravity can aid research in drug development and delivery, biotechnology, basic cell biology, protein and inorganic crystal growth, bone and invertebrate development, immune deficiencies, manufacturing processes and fluid sciences.

The experiments represent the second flight of the Commercial MDA ITA Experiments (CMIX-2) payload and should provide scientists and engineers with some 400 data points from which they can focus and expand their research in microgravity.

NASA's Office of Advanced Concepts and Technology is sponsoring CMIX-2, with program management provided by the Consortium for Materials Development in Space (CMDS), a NASA Center for the Commercial Development of Space (CCDS), based at the University of Alabama in Huntsville (UAH).

CMIX-2 is part of an innovative program between the UAH CMDS and ITA, Inc., Exton, Penn., to provide the CCDS community with increased access to space. The program will use ITA-developed hardware on a total of five Shuttle missions. In exchange for the flight opportunities, ITA is providing 50 percent of its hardware capacity to the UAH CMDS.

The CMIX-2 hardware consists of four Materials Dispersion Apparatus (MDA) Minilabs, two of which will contain experiments developed by the UAH CMDS and its industry affiliates. The other two, commercially marketed by ITA, will contain experiments developed by ITA's customers, which include U.S. biomedical technology and biomaterials companies, international users and university research institutions.

A percentage of ITA's MDA capacity will include high school student experiments as part of the company's Student Space Education Program to increase awareness and interest in science and space technology.

The MDA Minilab is a brick-sized, automated device capable of bringing into contact and mixing up to 100 separate samples of multiple fluids and/or solids at precisely timed intervals. The MDA, which is housed in a Commercial Refrigerator/Incubator Module (CRIM), uses four techniques for sample contact/mixing, including liquid-to-liquid diffusion, vapor diffusion, magnetic mixing and reverse gradient diffusion.

In addition, live cell investigations will be conducted in ten Bioprocessing Modules (BPM), which contain 60 to 100 times more fluid volume than the MDAs. The BPMs will be flown "piggy back" using available space in the CRIM, between the MDAs.

The MDAs and BPMs each have a specific advantage to the research being conducted on this flight. The MDAs can process a number of experiments using small volumes (0.2-0.5 milliliters) of sample materials. On the other hand each BPM can process only one or two experiments using a large volume (4-6 milliliters) of sample materials.

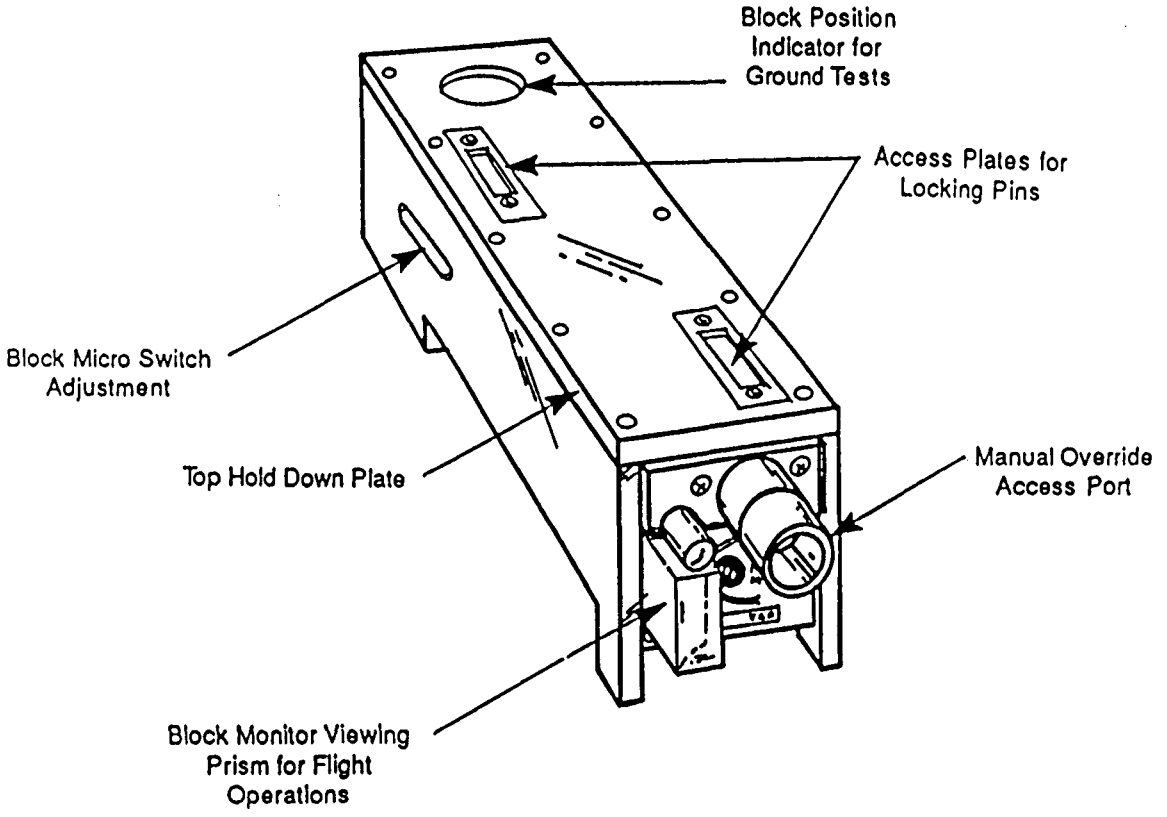
Experiment Descriptions

Experiments developed by the UAH CMDS and its affiliates include:

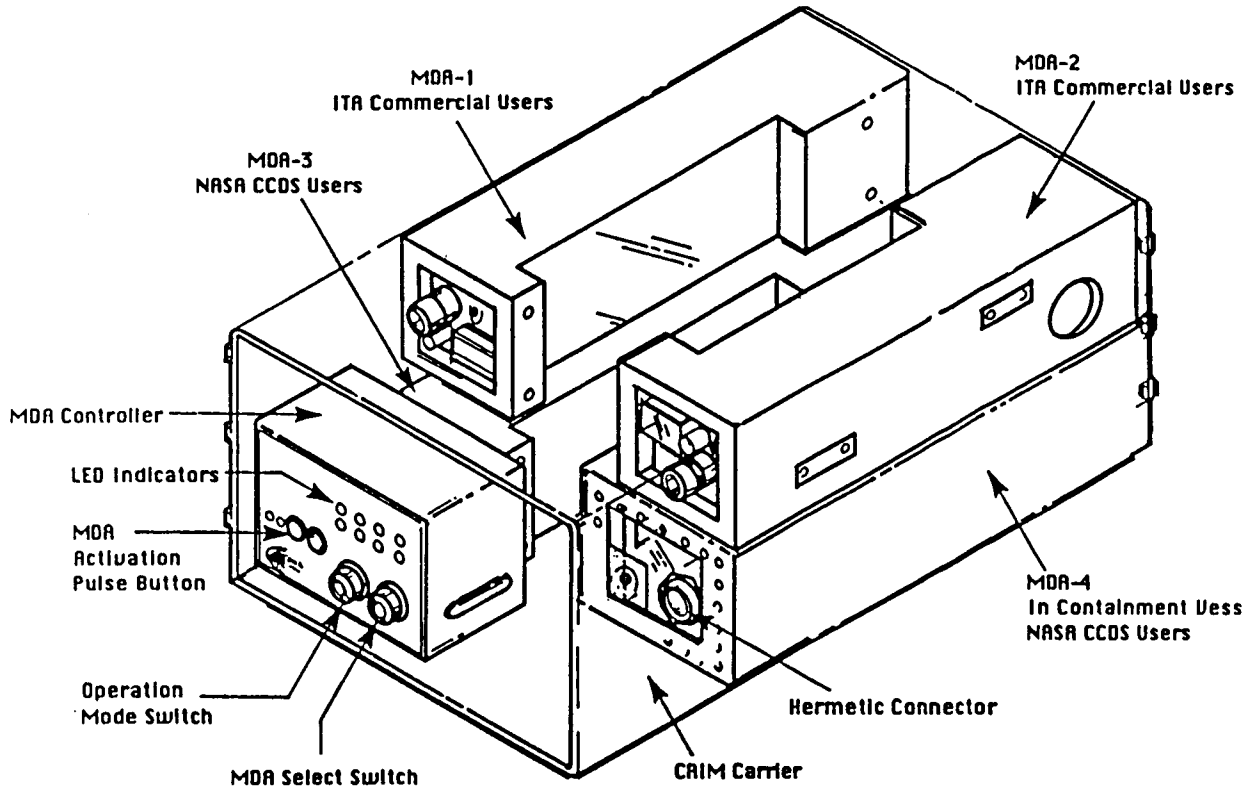
* Bone Cell Differentiation (MDA): Mouse bone cells will be evaluated on how well they grow and produce collagen in microgravity. Information from this experiment will contribute to a database on potential areas for drug treatment of osteoporosis. Potential commercial applications (3-10 years) include developing ways to enhance bone cell growth and prevent bone deterioration in astronauts and the elderly.

* Immune Cell Response (MDA): This experiment will obtain information on why some cells are more sensitive to microgravity than others. Once this is understood, techniques may be developed to stimulate immune system cells for use in treating immune suppressed patients and in developing and testing drugs to reduce some of the undesirable effects of microgravity.

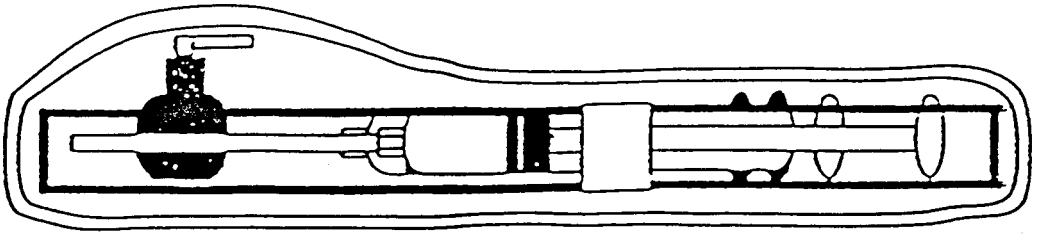
ITA's Materials Dispersion Apparatus (MDA) Minilab



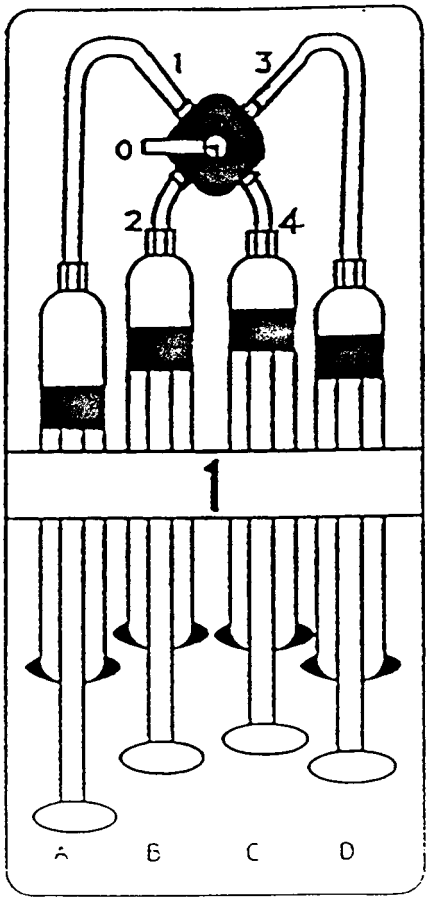
MDA Minilab Hardware Configuration for the CMIX-2 Mission on STS-56



Bioprocessing Module Containment Levels



TWO HEAT-SEALED FEP TEFLON BAGS

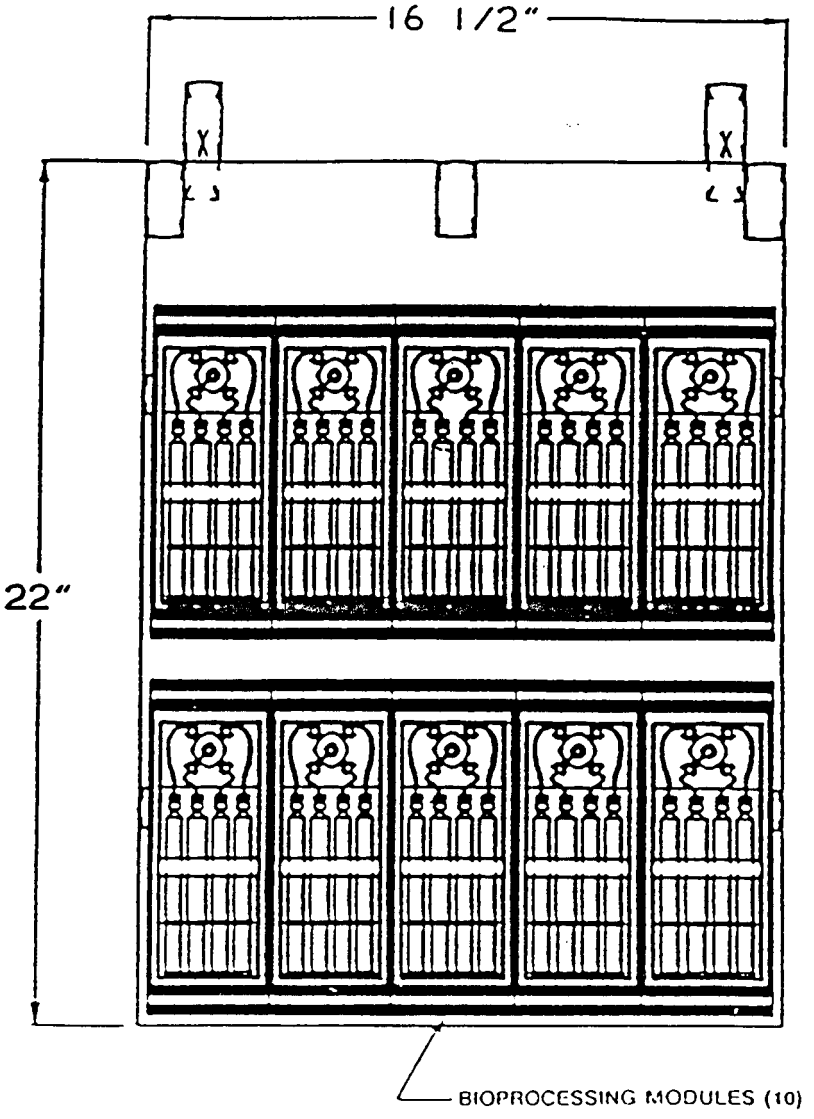


TEFLON TUBING

FOUR-WAY VALVE

SYRINGE-PLUNGER ASSEMBLY

Bioprocessing Module Stowage Pouch (Open)



* Diatoms (MDA): Minute plant cells (diatoms) encased in a silicone coating can be used to generate oxygen. This experiment will collect information on how microgravity affects these one-celled plants to determine if they can be used commercially to regenerate oxygen.

* Mouse Bone Marrow Cells (MDA): This experiment will obtain information on whether microgravity can enhance expansion of desirable cells by manipulating them with growth factors. Potential applications include bone marrow transplants and reconstituting the immune system after radiation therapy and chemotherapy treatments for leukemia, lymphoma and breast cancers.

* Nerve/Muscle Cell Interactions: Using frog cells, this experiment will study how microgravity affects the development of nerve cell communication which is essential for brain function. Results from this experiment may be relevant to the ability of higher organisms to undergo normal brain development in space. Information from this experiment will increase a database on nerve cell development in space, which will help to identify future potential commercial applications.

* Phagocytosis (MDA): To fight infection, one of the body's defenses is to rid itself of invading organisms, such as bacteria, by the process of phagocytosis (a means by which certain cells engulf and destroy foreign materials). This experiment will evaluate the phagocytic function of certain cells in microgravity. The expected long-range benefit is a better understanding of the behavior of these disease-fighting cells.

Other experiments conducted in the MDA will evaluate fluids mixing, invertebrate and bone development, virus subunit assembly and collagen self-assembly, and formation of drug encapsulated liposomes. Commercial applications of these experiments include developing a database for potential commercial processes and services, which use individual cells to determine the effects of microgravity and to develop and test drugs in space. As the database on cell response and control is enlarged, growth of commercial applications can be expected.

* Live Cell Investigations (BPMs): Experiments conducted in the BPMs are designed to gain information on how cells of the human immune system may be induced to grow when exposed to certain compounds. Once scientists discover how cells respond to these compounds in microgravity, techniques may be developed to select for certain desirable cell types. These cells types produce factors (e.g., interferons) that stimulate other cells to grow and are used to treat certain types of cancer.

Experiments developed by ITA and its affiliates include:

* Collagen Reconstitution (MDA): This experiment will study collagen fibril growth in microgravity to develop unique and complex products that mimic natural tissue structures. Potential applications include corneal and intraocular implants, bone repair materials and tendon/ligament grafts.

* Microencapsulation (MDA): Drug microencapsulation techniques will be studied to improve chemotherapy drug delivery, to encapsulate inhalant medications and to enhance radiographic (x-ray) procedures.

* Urokinase Protein Crystal Growth (MDA): Urokinase will be used to grow crystals to help determine the enzyme's three-dimensional (3-D) structure for use in developing a blocking or therapeutic drug that prevents the spread of breast cancer.

* Bacterial Aldolase and Rabbit Muscle Aldolase Protein Crystal Growth (MDA): Two types of aldolase will be used to grow crystals to determine the enzymes' 3-D structures for use in research on genetic illnesses.

* HIV Reverse Transcriptase (MDA): Reverse Transcriptase will be used to grow crystals to determine the enzyme's 3-D structure for use in AIDS research.

* RNA Protein Crystal Growth (MDA): Ribonucleic acid (RNA) will be used to grow crystals to determine the enzyme's 3-D structure for use in cell pharmacology and in designing continuous catalytic reactors.

* Methylase Protein Crystal Growth (MDA): This experiment will grow crystals to study the interaction between methylase and deoxyribonucleic acid (DNA) for use in identifying potential biomedical/biotechnology applications.

* Lysozyme Protein Crystal Growth (MDA): Lysozyme will be used to grow crystals to confirm the quality of flight conditions and to extend on-going studies of lysozyme crystallization for biomedical applications.

* DNA-Heme Protein Crystal Growth (MDA): This experiment will grow crystals to study their 3-D structure for use in identifying potential biomedical/biotechnology applications.

* Brine Shrimp Development (MDA): Brine shrimp development will involve hatching tiny Artemia Salina shrimp eggs in space to determine how microgravity affects early development. The shrimp are being studied as a potential space food source.

* Cell Research (MDA): This experiment will explore fluids and cell mixing for cell culturing on Space Station Freedom.

Other commercial MDA experiments include inorganic assembly (proprietary), myoglobin protein crystal growth, dye and yeast cell diffusion, and engineering tests. Potential commercial applications are expected in areas such as environmental sciences, drug research and development and cell pharmacology. Engineering tests will be performed to obtain data on liquid-to-liquid diffusion and magnetic mixing rates to verify normal MDA operations and provide "baseline" diffusion data.

* Mustard Seed Germination (MDA-student): Seeds and newly developing reproductive tissue of Brassica Rapa will be flown. The seeds will be dry and the tissue will be immersed in an inert culture medium. The materials returned will be used to propagate successive generations of the plant to assess any long-term effects on heredity patterns. This is a follow-on to an STS-52 experiment.

* Fish Egg Hatching (MDA-student): Using fish eggs, this experiment will study how microgravity affects the hatching process of the annual killifish of Zanzibar, Africa.

* Heart Cells In Culture (MDA-student): Using heart cells, this experiment will attempt to determine the effect(s) of microgravity upon the morphology and rate of heart "beats" of heart muscle cells.

* Mushroom Spore Generation (MDA-student): Using a selected strain of Agaricus bisporus (the cultivated mushroom), this experiment will attempt to determine the effect(s) of microgravity on the development of mushroom spores. The spores then will be used as a comparison and later, lead to the eventual growth of new and improved mushrooms.

* Mustard-Spinach Seed Germination (MDA-student): This experiment will attempt to determine the effects of microgravity on the mustard-spinach seed germination process. The germinated seeds will be compared with Earth-grown sprouts.

On-orbit Operations

The MDA minilabs each consist of an upper and lower block that contain a matching number of "wells" (holes) filled with different substances. The blocks are aligned at launch so that the holes do not "line up" and the materials in the wells do not touch each other. When the proper microgravity level is reached, the upper blocks will be moved in relation to the lower blocks so the materials in matching wells come into contact to allow dispersion (or mixing) of the different substance.

To complete microgravity operations, the blocks again will be moved to bring a third set of reservoirs to mix additional fluids or to fix the process for selected reservoirs. A prism window in each MDA allows the crew member to determine the alignment of the blocks.

To activate the MDAs, the crew will open the CRIM door to access the MDAs and the MDA Controller and Power Supply. Activation will occur simultaneously and is required as early as possible in the mission, followed by minimum microgravity disturbances for a period of at least 8 hours. The crew will operate switches to activate each MDA, and once all the MDAs are activated, the CRIM door will be closed.

Deactivation of each MDA will occur automatically at different intervals. For example, one MDA will automatically deactivate within minutes of being activated, whereas one will not deactivate at all. Deactivation of the other

two MDAs will occur later in the mission. Once the Shuttle lands, the MDA minilabs will be deintegrated and the samples will be returned to the researchers for post-flight analyses.

The crew also will activate the BPMs, which consist of four plastic syringes. The syringes are interconnected by tubing to a four-way valve attached to an aluminum tray. The first syringe of each BPM will contain live cells. The second syringe will contain a mediator of cell growth or function (e.g., an activator), and the remaining two syringes will contain a chemical fixative.

To activate the BPMs, the crew will open the BPM valve to mix the cells with growth mediator. After specified times, the crew will terminate each BPM test by turning the valve to mix cells with fixative to preserve cellular structures in space before returning to Earth. Post-flight analyses will evaluate cell growth and production of materials, including interferons.

Principal Investigator for the CMIX-2 payload is Dr. Marian Lewis of the UAH CMDS. John Cassanto, President, ITA, is Program Manager for the commercial MDAs.

SPACE TISSUE LOSS-3 (STL-3)

Bone and Muscle Cell Culture Experiments

NASA Principal Investigator:
Emily R. Morey-Holton, Ph.D.
Ames Research Center, Mountain View, Calif.

U.S Army Principal Investigator:
George Kearney, Ph.D.
Walter Reed Army Institute of Research, Washington, D.C

The musculoskeletal system is subjected to constant load by the gravitational acceleration of the Earth. The structure and function of bone and muscle tissue has been shaped throughout evolution by this constant stress. The impact of diminution of this acceleration is not understood but may have profound influence on the function of these gravity-related systems.

Muscle tissue in space-flown animals and humans has been shown to respond to exposure to the orbital environment by loss of contractile protein, alteration in the energy provision mechanisms within the cells and changes in the structure of nerve/muscle interfaces. When growing bones are unloaded in space, bone growth is slowed; bones show delayed maturation which translates to an increase in mass and mineral content without the anticipated increase in bone strength.

The changes in the musculoskeletal system are most pronounced in, but not limited to the weight-bearing limbs. These changes hinder one's capability to function when returning to Earth. The bone changes coupled

with the decrease in the mass of the gravity-dependent muscles make movement difficult, and the individual may be prone to accidents because of this instability.

The working hypothesis of the STL project is that the influence of gravity is active at the level of individual cells and that totally defined cellular models of the changes noted in whole animal preparations can be developed to study the process at the molecular level. The ultimate aim of the project is to delineate the biochemical pathways and mechanisms responsible for the noted changes and test the feasibility of pharmaceutical intervention to slow, arrest or reverse the progress of the tissue loss.

The current mission will be used to reproduce and verify the changes in cell function observed in the two previous deployments on the Shuttle. Changes in protein levels, enzyme activities and gene functions will be monitored. Alteration in the morphology and nature maturation of the cells will be determined upon return and followed for an extended period of recovery. These results will be compared to changes noted in space-flown whole animal function to establish the validity and applicability of the cellular model.

The significance of the current muscle cell experiments is threefold. First, previous results have indicated that the process of development and differentiation in cultured muscle satellite cells is impaired by an apparent disruption of the ability of the precursor cells to fuse to form muscle fibers. These cells function in the normal repair process for muscle so impact on the ability of the cells to fuse is considered clinically significant. Recovery of muscle mass and strength following spaceflight might be hastened if these cells are fully functional during the repair process in the muscle following return to normal gravity.

The second area of significance is the apparent stability of the changes noted. Space flown cells were unable to fuse for some 40 cell cycles following return (35 days). Ground control cells were 100 percent fused within 12 days. Most reported alterations in cell function only have been shown to persist for hours to days following return to normal gravity conditions. Changes in the function of the muscle cells are the most stable reported thus far. If initial observations are verified in the current experiment, these cells would allow extensive ground-based study of the affects of space flight without the need for constantly replenished supplies of experimental material that are changing while the experiments are in process.

A third area for potential application of data from this project is satellite call therapy. Disorders impacting muscle tissues such as the muscular dystrophies are logical targets for gene replacement therapy. The gene involved in Duchenne muscular dystrophy is the largest known and delivery with viral carriers is probably not feasible. Generically altered satellite cells currently are being studied for use as carriers for replacement genes. This uses the natural reparative system of the muscle to effect restoration of function. The impairment of natural fusion potentially allows production of

therapeutically significant numbers of satellite cells from clones known to express the desired genetic properties but without foreign surface antigens which would necessitate immunosuppression of the transplant recipients.

The significance of the bone cells experiment also is threefold. Previous results from STL have indicated that the metabolism of bone forming cells may change during space flight and that mineralization of the bone fibers (matrix) may be impaired. Such changes at the whole bone level would cause decreased bone strength. The results will be repeated and expanded. For example, the type and amount of bone-specific products that the cells contain at the end of this 8-day flight will be studied. In addition, cells will be cultured upon return to Earth to determine if the spaceflight induced changed can be reversed after return to Earth.

Finally, the amount and type of product found in the cell culture will be compared to similar data being obtained in the whole rat (experiment PARE.03 below) to determine if spaceflight changes in bone cell cultures are similar to those found in the animal. Decrease in the activity of the bone forming cells can alter the amount and type of bone formed and contribute to the changes in bone strength. Focusing on the initial event in the bone adaptation process by analyzing cell changes during flight will help us determine if the changes at the cellular level trigger the changes in bone strength. Understanding what gives bone its strength would be of great value in treating individuals at risk for bone fracture or for better understanding why some people have weak bones.

PHYSIOLOGICAL AND ANATOMICAL RODENT EXPERIMENT.03

The third Physiological and Anatomical Rodent Experiment (PARE.03) on STS-56 is a secondary payload that will fly in a locker in the Space Shuttle's mid-deck.

PARE.03 consists of two experiments (PARE.03A and PARE.03B) with different goals and different principal investigators. Both will share the same group of rats. The goals of each experiment are fully compatible with the procedures and goals of the other. Both experiments endeavour to get new data that will provide a cohesive view of bone biology during and following spaceflight.

Acute Adaptation of Bone to Spaceflight (PARE.03A)

Principal Investigator:
Emily R. Morey-Holton, Ph.D.
Life Science Division
NASA-Ames Research Center
Mountain View, Calif.

Co-Investigator: Russell T. Turner, Ph.D.
Department of Orthopaedics
Mayo Clinic
Rochester, Minn.

The load imposed by Earth's environment throughout evolution has determined the size, shape and strength of the skeletal system. When growing bones are unloaded on Earth or in space, bone growth is slowed. (In unloading, the rat is placed in tail traction so its hind legs no longer bear weight. The rat can move freely using its front paws. This technique simulates many, but not all, of the effects of microgravity on rat bones.) Bones show delayed maturation, which translates to an increase in mass and mineral content without the expected increase in bone strength.

The major hypothesis of this project is that gravity is necessary for normal development of bone structure. Another part of the hypothesis is that decreased gravity or skeletal unloading causes defective skeletal growth. This defective growth is characterized by delayed maturation and increased bone mass without increased bone strength.

The proposed flight experiment is designed to confirm the bone defects measured in past flight experiments. These measurements include bone mass, mineralization rates and strength at multiple sampling sites. The experiment also will focus on sites and molecular mechanisms of the growth defect.

In addition, scientists will observe recovery from spaceflight to determine if the defects are corrected by return to Earth after either 36 or 72 hours. During the Space Shuttle mission, scientists on the ground will perform the same experiment, using a ground-based rat model that simulates certain aspects of spaceflight. This will help determine the validity of this system for predicting spaceflight responses in bone.

PARE.03A is important for two reasons. When individuals are exposed to the microgravity of space or unloading on Earth, there appears to be a change in bone structure. In unloading, the rat is placed in tail traction so its hind legs no longer bear weight, but the rat can move freely using its front paws. This technique simulates many of the effects of microgravity on rat bones.

Perhaps muscle no longer exerts enough force or bone, by itself, is not stimulated to combine bone cell activity, cell products and mineral into a bone structure that is as strong as a bone produced on Earth.

Regardless of the cause, the changes in bone structure hinder one's capability to function when returning to Earth. Movement patterns are difficult, and the individual may be prone to bone fractures because of this instability. We need to find out what parts of the bone structure are changed. We also need to determine the extent to which they change, the impact of the changes on bone strength and how to prevent the changes from occurring.

Second, unloading of the bones on Earth causes changes in the production of various bone cell products. Suggestions of similar changes have been reported in rapidly growing rats during short-duration spaceflights. The altered products cause an imbalance of the normal

ordered array of bone structure, resulting in a weaker bone. However, the imbalance may be different during spaceflight than during unloading on Earth. If the imbalance is different, then the mechanisms responsible for the weaker bone may be different in space than on Earth. This would require different treatments to prevent the changes. Thus, one part of this flight experiment is an Earth-based experiment on rats of the same age unloaded on Earth.

The PARE.03A project will examine the extent to which the bone-forming cells change their activity after exposure to microgravity for 8 days. It also will investigate whether these changes are reversed within 3 days of return to Earth.

Cell Kinetic and Histomorphometric Analysis of Microgravitational Osteopenia (PARE.03B)

Principal Investigator:
W. Eugene Roberts, D.D.S., Ph.D.
Co-Investigator:
Lawrence Garetto, Ph.D.
Departments of Orthodontics and Physiology/Biophysics
Indiana University Schools of Dentistry and Medicine, Indianapolis, Ind.

The influence of gravity on the development and function of bone-forming cells (osteoblasts) is a basic biological question that may be common to many gravity-sensing organisms. Because the production of bone-forming cells is mechanically sensitive, the force exerted by gravity is an important experimental variable for understanding mechanisms underlying osteoblast production.

Gravity is a ubiquitous force that is inescapable on Earth. As such, all Earth-bound organisms have evolved under the presence of this force. Data from both human and animal experiments suggest that exposure to the microgravity environment of space may alter the normal "turnover" or renewal processes of the skeletal bones. Under normal conditions in Earth's gravity field, the turnover process is the result of a balance between bone removal and bone formation. However, during spaceflight, bone formation is inhibited. As a result, the turnover of bone is unbalanced, resulting in a net loss.

Previous experiments on both American and Russian missions have shown that a lack of gravity appears to interfere with production of osteoblasts in animals subjected to spaceflight. This, in turn, ultimately may result in reduced or altered capability to form bone mass in these animals. Mechanical force is known to influence the formation of preosteoblast cells. The main hypothesis of this experiment is that osteoblast production is blocked during spaceflight but rapidly recovers within hours to days after return to Earth's 1-g environment.

As mentioned previously, the process of normal osteoblast production may have evolved with gravity as an essential co-factor. This important

question is most effectively addressed by studying the effects of the removal of gravity on different types of bone tissue.

The PARE.03B experiment will examine how the lack of gravity encountered during spaceflight affects the production of osteoblasts. One goal is to use a specific marker for DNA synthesis to examine preosteoblast cell proliferation. This has not been done previously following spaceflight and will provide new and unique data on the mechanism of osteoblast production.

A second goal is to confirm previous data suggesting that preosteoblast production is inhibited immediately following spaceflight. The third goal of this study is to determine if the block in osteoblast formation occurs throughout the skeleton or if it is localized in specific types of bones. This will be measured by examining the process in different bones. These include the bones of the upper and lower jaw, which are non-weightbearing but mechanically loaded in function; the shin bone (tibia), which is weightbearing and the bones of the lower back.

These vertebral bones differ from other bones in the rat in that they are continuously undergoing a balanced turnover or renewal process. In other words, they undergo both removal by osteoclasts and new bone formation at other sites by osteoblasts.

Finally, a fourth goal is to determine how soon osteoblast production recovers after return to Earth. Measurements made immediately following return to Earth will be compared in animals allowed to recover for 36 and 72 hours.

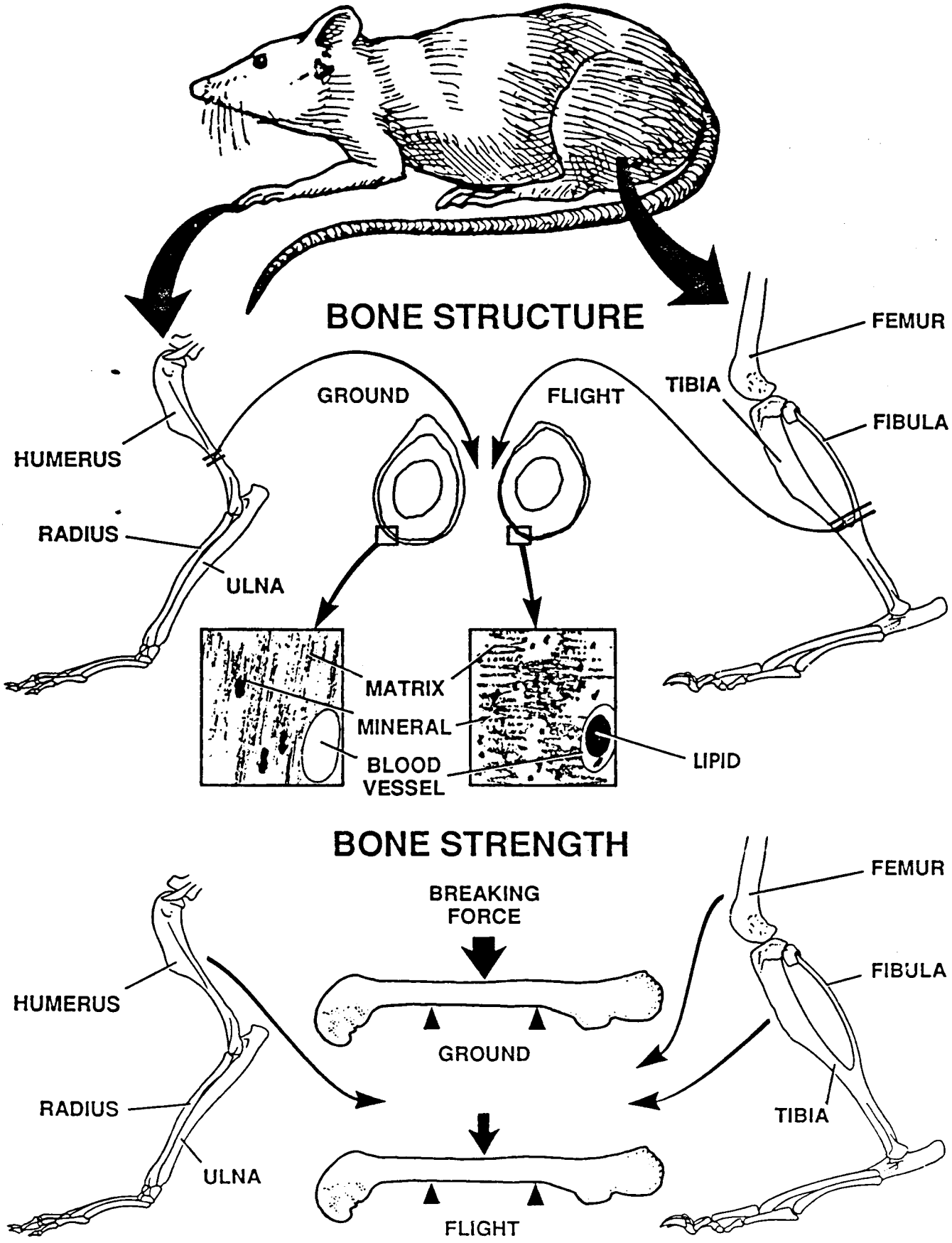
The PARE.03B experiment will provide basic insights into the cellular mechanisms of the mechanical control of osteoblast production and function in bone. This kind of detailed knowledge at the cellular level may provide biological insights into mechanisms underlying bone diseases in humans on Earth. Bone diseases such as osteoporosis affect a large segment of society. They result in billions of dollars in yearly health care and related costs due to lost productivity. Successful treatment of diseases such as these requires a sufficient understanding of the basic biology of osteoblast production to adequately and accurately develop treatment regimens.

PARE.03B will provide additional short-term flight data to that already collected on previous missions. It will provide new information on preosteoblast cell proliferation following spaceflight. In addition, it will extend our understanding of the recovery process of osteoblast production following return to a 1g environment. These experiments will yield answers to basic biological questions about the ability of Earth-evolved animals to adapt outside of their original evolutionary environment. This will better enable us to understand the role that mechanical force plays on Earth in maintaining our skeleton.

During spaceflight, changes have been noted in both the forelimbs and hindlimbs of growing male rats. Studies on the humerus and tibia have shown a decrease in the amount of bone formed during flight. In the cross sectional area of bone depicted under "Bone Structure", a bone marker was given to the animals prior to flight. The marker forms the line inside the bone section. The amount of bone formed during flight is the area between the marker and the outer bone surface.

During the same period of time, the ground animals form about 45 percent more bone at the surface of the bone shaft. If a similar area from each section (boxes) is enlarged, further differences between the flight and ground control rats can be seen.

In the flight bone, surface blood vessels appear to be blocked with debris and lipid deposits, the mineral may aggregate in smaller crystals and the collagen may be some what disorganized in a convoluted pattern. These changes may be responsible for the changes in bone strength. Data from the humerus, femur and tibia suggest that the flight bone is about the same size as the ground control bone, yet the amount of force required to break the bone is significantly less in the flight animals (see "Bone Strength"). In fact, the strength of the bone does not appear to increase as the bone increases in size, suggesting that bone deposited during flight does not contribute to bone strength.


BONE STRUCTURE
FEMUR
TIBIA
FIBULA
GROUND
FLIGHT
HUMERUS
RADIUS
ULNA
MATRIX
MINERAL
BLOOD VESSEL
LIPID
BONE STRENGTH
FEMUR
BREAKING FORCE
FIBULA
HUMERUS
GROUND
RADIUS
TIBIA
ULNA
FLIGHT

STS-56 Crew Biographies

Kenneth D. Cameron, 43, Col., USMC, is Commander of the second Atmospheric Laboratory for Applications and Science (ATLAS) mission. Selected to be an astronaut in 1984, Cameron, from Cleveland, Ohio, is making his second Shuttle flight.

Cameron served as Pilot on Atlantis' STS-37 mission in April 1991 which featured the deployment of the Gamma Ray Observatory.

A graduate of Rocky River High School in Rocky River, Ohio, in 1967, Cameron received bachelor and master of science degrees in aeronautics and astronautics from the Massachusetts Institute of Technology in 1978 and 1979, respectively.

Cameron enlisted in the Marine Corps in 1969 and earned a commision in 1970 at Officer's Candidate School in Quantico, Va. He received his naval aviator wings in 1973 and has logged over 3,400 hours flying time in 46 different types of aircraft.

Stephen S. Oswald, 41, is the Pilot of STS-56. Selected as an astronaut in 1985, he was born in Seattle, Wash., but considers Bellingham, Wash., his hometown. He made his first flight as the Pilot aboard Discovery on STS-42 in January 1992, an international microgravity laboratory mission.

Oswald graduated from Bellingham High School, Bellingham, Wash., in 1969 and received a bachelor's degree in aerospace engineering from the Naval Academy in 1973. He was designated a naval aviator in September 1974 and flew the Corsair II aboard the USS Midway in the Western Pacific and Indian Oceans from 1975 through 1977. In 1978, Oswald attended the Naval Test Pilot School.

After leaving the Navy, he joined Westinghouse Electric Corp. as a test pilot in developmental flight testing of various airborne weapons systems, including the F-16C and B-1B radars. Oswald remains active in the U.S. Naval Reserve, currently assigned as Commanding Officer of the Naval Space Command Reserve Unit, Dahlgren, Va. Oswald has logged more than 5,400 hours in 40 different aircraft and has logged over 193 hours in space.

Michael Foale, Ph.D., 36, will serve as Mission Specialist 1 (MS1), making his second space flight. Selected as an astronaut in 1987, Foale considers Cambridge, England, his hometown.

Foale graduated from Kings School, Canterbury, England, in 1975. He attended the University of Cambridge, Queens' College, receiving a bachelor of arts degree in physics in 1978. He completed a doctorate in laboratory astrophysics at Cambridge University in 1982.

Prior to his selection as an astronaut in 1987, Foale worked for NASA as a payloads officer in Mission Control at the Johnson Space Center, Houston. He made his first space flight on STS-45, the first Atmospheric Laboratory for Applications and Science flight.

Kenneth D. Cockrell, 42, will serve as Mission Specialist 2 (MS2) and will be making his first space flight. Selected as an astronaut in 1990, Cockrell considers Austin, Texas, his hometown.

Cockrell graduated from Rockdale High School, Rockdale, Texas, in 1968, received a bachelor of science degree in mechanical engineering from the University of Texas in 1972 and a master of science degree in aeronautical systems from the University of West Florida in 1974.

Cockrell received a commission through the Naval Aviation Reserve Officer Candidate program at the Naval Air Station in Pensacola, Fla., in 1972 and was designated a naval aviator in 1974. He has flown various types of aircraft and has logged over 4,900 flying hours, including 650 aircraft carrier landings.

Ellen Ochoa, Ph.D., 34, will serve as Mission Specialist 3 (MS3) on STS-56. She was born in Los Angeles, Calif., but considers La Mesa, Calif., her hometown. Selected as an astronaut in 1990, Ochoa will be making her first space flight.

Ochoa graduated from Grossmont High School in La Mesa in 1975. She received a bachelor of science degree in physics from San Diego State University in 1980 and received a master of science degree and a doctorate in electrical engineering from Stanford University in 1981 and 1985, respectively.

Upon graduation from Stanford, Ochoa served on a research staff position at Sandia National Laboratories, Livermore, Calif., specializing in work with optical processing. In 1988, she joined NASA's Ames Reserach Center, Moffett Field, Calif., to work with optical recoginition systems for space automation. At the time of her selection as an astronaut, Ochoa was serving as Chief of the Intelligent Systems Technology Branch at Ames.

MISSION MANAGEMENT FOR STS-56

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NASA Headquarters, Washington, D.C.

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Bryan O'Connor - Deputy Associate Administrator
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Mr. Earl Montoya - ATLAS 2 Program Manager
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Dr. Timothy Miller - Mission Scientist, Atmospheric Laboratory for Applications and Science - 2
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Victor Keith Henson - Manager, Redesigned Solid Rocket Motor Project
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Parker Counts - Manager, External Tank Project

Johnson Space Center, Houston

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Stennis Space Center, Bay St. Louis, Miss.

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Gerald Smith - Deputy Director
J. Harry Guin - Director, Propulsion Test Operations

Ames-Dryden Flight Research Facility, Edwards, Calif.

Kenneth J. Szalai - Director
Robert R. Meyers, Jr. - Assistant Director
James R. Phelps - Chief, Shuttle Support Office.

Goddard Space Flight Center, Greenbelt, Md

Dr. John Klineberg - Center Director
Thomas E. Huber - Director, Engineering Directorate
Robert Weaver - Chief, Special Payloads Division
David Shrewsberry - Associate Chief, Special Payloads Division
Jack Pownell - Spartan Mission Manager
Frank Collins - Spartan Project Manager
Richard Fisher - Spartan Principal Investigator

DEPARTMENT OF DEFENSE SECONDARY PAYLOAD MANAGEMENT

Key Management Partipants

Mission Director: Lieutenant General Edward P. Barry, Jr., USAF, Commander, HQ Space and Missile Systems Center, Los Angeles AFB

Deputy Mission Director: Colonel Robert H. Ballard, Program Manager, Space Test and Small Launch Vehicles Program, Hq, Space and Missile Systems Center, Los Angeles AFB

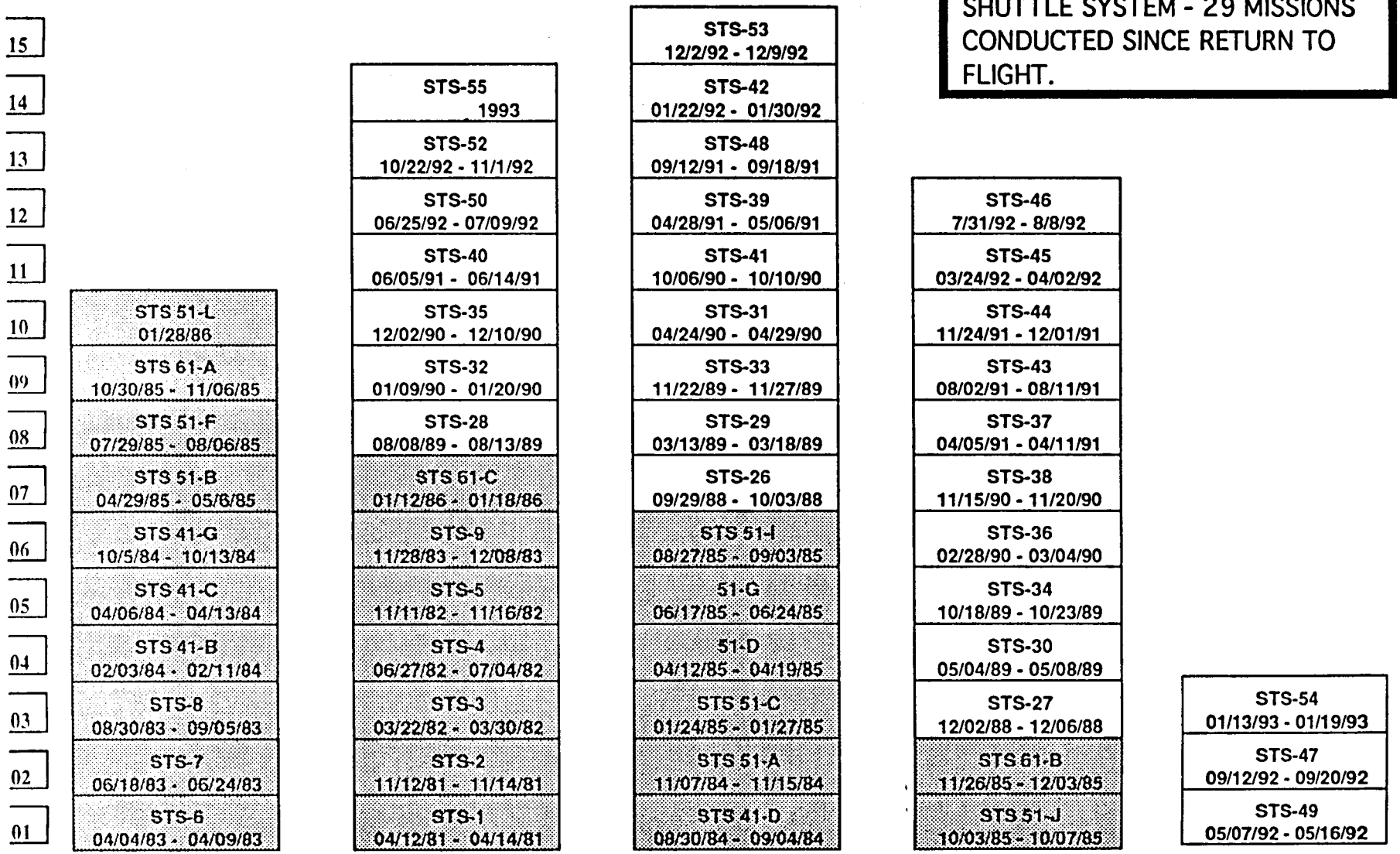
Assistant Deputy Mission Director: Lt. Colonel James McLeroy, Executive Director, Operating Location AW (HQ Space and Missile Systems Center), at Johnson Space Center, Houston

USAF Secondary Payload Managers (JSC/OL-AW):

Capt. David Goldstein
Capt. Richard Martinez
Capt. Reid Maier
Capt. John Hennessey

SHUTTLE FLIGHTS AS OF FEBRUARY 1993

54 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM - 29 MISSIONS CONDUCTED SINCE RETURN TO FLIGHT.



NASA News

National Aeronautics and
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Washington, D.C. 20546
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Headquarters, Washington, D.C.
(Phone: 202/453-2754)

For release February 22, 1993

Don Nolan
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RELEASE: 93-035

NASA SAVES $1 MILLION ON AERONAUTICS RESEARCH PROJECT

NASA and industry engineers have designed and built a new measuring device that will save American taxpayers more than $1 million on a NASA research program.

The device is a greatly-improved "inlet rake" that will measure the air flowing into one of the engines on the F/A-18 High-Alpha Research Vehicle (HARV), based at NASA's Ames-Dryden Flight Research Facility, Edwards, Calif. Engineers could use the air flow data to help give fighter-type aircraft more power and better handling qualities.

"This rake is more compact and requires many fewer changes to the aircraft than those we used in the past. This equals a total savings of more than $1 million in the HARV program budget," said Ronald Ray, Propulsion Group Leader at Dryden.

"This new rake actually saved the program," Ray added. "Without it, we would not have enough funding to continue."

The new rakes may save NASA even more money. The rake will work on all General Electric F404 engines, so Dryden could use the devices on the facility's other F/A-18s and on the X-31 research plane with minor modifications.

Dryden engineers came up with the idea for the new inlet rake and presented it to General Electric Corp., Evendale, Ohio, who agreed to design and build two of the devices. They will arrive at Dryden 6 weeks ahead of schedule and $60,000 below budget.

- more -

The rake is part of a joint effort by Dryden and NASA's Lewis Research Center, Cleveland, to develop and validate better ways to design engine inlets. The rake data will be used to improve computer codes and wind tunnel test techniques. Lewis leads the study.

Most of the million-dollar savings results from the simplicity of the new rake, which is centrally mounted like a wagon wheel 8 inches in front of the engine. Installation time for the old design would have been up to 1 year and NASA would have incurred more costs for the extensive modifications required to the F/A-18 HARV aircraft.

NASA's high angle-of-attack (or "high alpha") technology program studies what happens when a modern fighter aircraft like the F/A-18 flies forward with its nose tilted up at a sharp angle to its flight path. The research includes simulations on supercomputers, wind tunnel tests and flights with the F/A-18 HARV.

"Early computer predictions have shown a greater thrust loss than we originally thought existed," Ray said. "If we can improve engine inlet design, it will increase the power and handling qualities of highly maneuverable aircraft. The new rake will be a vital tool in our search for a better inlet."

The high-alpha technology program involves three other NASA field installations: Ames Research Center, Mountain View, Calif.; Langley Research Center, Hampton, Va. and Lewis Research Center, Cleveland.

- end -

NOTE TO EDITORS: A photograph of the new inlet rake is available by calling the Headquarters Broadcast and Imaging Branch, 202/358-1900.

Color: 93-HC-61

B&W: 93-H-68

NASA News

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For Release
Feb. 24, 1993

Bob MacMillin
Jet Propulsion Laboratory, Pasadena, Calif.
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N93-08: NOTE TO EDITORS

NASA TO BRIEF PRESS ON TOPEX/POSEIDON MISSION

New findings on the El Nino ocean current will be among topics discussed at a press conference on the TOPEX/Poseidon satellite mission on Friday, Feb. 26, at 1 p.m. EST, in the von Karman Auditorium at NASA's Jet Propulsion Laboratory, Pasadena, Calif.

Scientists will discuss initial results from the U.S.-French TOPEX/Poseidon satellite, which was launched Aug. 10, 1992, to map circulation of the world's oceans and study the oceans' role in climate. The press conference comes at the end of a week-long conference attended by more than 150 TOPEX/Poseidon scientists and oceanographers from around the world.

Participants will include Charles Yamarone Jr., JPL Project Manager; Dr. Lee-Lueng Fu, JPL Project Scientist; Dr. William Patzert, NASA Program Scientist; Michel Dorrer, French Project Manager; Michel Lefebvre, French Project Scientist; Jean-Francois Minster of the Centre National d'Etudes Spatiales, Toulouse, France; and James Mitchell of the Naval Oceanographic and Atmospheric Research Laboratory in Mississippi.

They will present results of the mission's verification phase, including the first map of ocean topography and a video animation of the global ocean current systems mapped by TOPEX/Poseidon.

The press conference will be broadcast live on NASA Select television with two-way audio from other NASA centers. NASA Select is carried on Satcom F2R, transponder 13, 72 degrees west longitude, C-band, frequency 3960 MHz, audio subcarrier 6.8 MHz, vertical polarization.

-end-

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For Release
February 25, 1993

RELEASE: 93-036

SUPERNOVA MAY HAVE CAUSED HUGE VOID AROUND SOLAR SYSTEM

A supernova that shone in the ancient sky like a second moon is the probable cause of a huge void known as the "Local Bubble" that envelopes the solar system and many nearby stars, a NASA scientist reported in today's issue of the British journal "Nature."

The bubble is an area about 300 light-years across that, compared to other parts of space, is relatively empty of gases except for super-hot hydrogen. The bubble's origin has been the subject of intense speculation for the last 20 years.

Now, researchers at NASA's Goddard Space Flight Center, Greenbelt, Md., say evidence suggests it was formed by the supernova or explosion of a star known as Geminga about 340,000 years ago.

"This is a supernova we didn't know about until last year. We put this new knowledge together with some other information about the Local Bubble, and we were able to say we think we know what happened here," said Dr. Neil Gehrels, of Goddard. Gehrels wrote the paper with Dr. Wan Chen, of Universities Space Research Association.

A supernova is an internal explosion that blows away a star's outer layers, leaving a dense, collapsed, rapidly spinning core that emits energy in pulses. Stars that have undergone a supernova are known as pulsars. The Local Bubble would have been formed by the force of the supernova blasting most of the gases out of the surrounding interstellar medium, according to the authors.

"This must have been the brightest supernova ever seen by Homo sapiens," said Gehrels. "Everybody would have immediately noticed it. It would have been quite a spectacular and frightening event, though not one that would have threatened the planet's existence."

- more -

Supernovas always create such bubbles, Gehrels said. Similar bubbles, including a cluster of several around the Local Bubble, probably were formed around our solar system millions of years ago by supernovas just as close as Geminga. But those would have collapsed and dissipated by now, leaving little or no trace of their existence, he said.

Astrophysicists have long speculated that the current Local Bubble was created by a supernova. But for that to have happened, the star would had to have been relatively nearby. Until recently, the evidence for that was scant, said Gehrels.

In the last year, however, several discoveries have given weight to the theory. Scientists at Goddard and Columbia University in New York City determined that Geminga is a pulsar and therefore had to have undergone a supernova at some point. That finding was made using x-ray data from the Roentgen Satellite and was confirmed by NASA's Compton Gamma Ray Observatory.

From Geminga's pulsations, scientists calculated that the star is no more than 340,000 years old and was about 180 light years away -- close enough to have created the bubble -- when the supernova occurred. The authors estimate Geminga has since moved to about 400 light-years away.

Further evidence recently presented by a team of Italian astronomers helped Gehrels and Chen place Geminga more precisely. Calculations based on its speed suggested the star was born in a position to have created the bubble. The Italian team also reported that the swiftness with which Geminga crosses the sky indicates it is not far away.

"So we now know the position for this nearby supernova," Gehrels said. "It is right near the current middle of the Local Bubble."

Gehrels said the supernova that created the bubble would have been a unique experience for anyone on Earth who witnessed it.

According to Gehrels, observers would have seen the sudden appearance of a star emitting as much light as the moon, visible even in daylight. With a full moon in the sky, the nights would have been twice as bright as usual. Geminga would have lingered like a beacon for several months before fading. Currently, it cannot be seen with the naked eye.

At the time of the supernova, intense x-rays and gamma rays from the explosion likely would have depleted the Earth's ozone layer by 10 to 20 percent globally, Gehrels said in remarks not included in the "Nature" paper. The resulting increase in ultraviolet radiation, he said, would have been small enough not to disrupt life on Earth but may have been noticed by early humans.

"Whomever was here back then would have experienced a sunburn for a year or two," Gehrels said. "One can only wonder if anybody at that time figured out that Geminga was the cause."

- end -

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For Release
February 25, 1993

RELEASE: 93-037

NASA FUNDS EXPERIMENT TO HELP COMMERCIALIZE TECHNOLOGY

Beginning this month NASA's latest experiment will test "technology incubation" -- a new laboratory-to-market approach designed to help space technology contribute to U.S. industrial competitiveness.

NASA's Office of Advanced Concepts and Technology began the 3-year technology commercialization experiment by funding two Technology Commercialization Centers, one at the its Ames Research Center, Mountain View, Calif., and the other at Johnson Space Center, Houston. The program, funded this year for $800,000, is being managed and will be operated by the IC2 Institute at the University of Texas, Austin.

The two NASA technology commercialization centers will be set up by the IC2 Institute's staff and will draw upon a regional network of entrepreneurs, investment capital, market and business savvy on the one hand and the NASA field center talent and technology pool on the other.

The two NASA centers were selected as test case areas because of the variety of technologies being developed at each center and the existing economic and business infrastructure to support those technologies in the two locales.

The IC2 Institute was selected by NASA because of its successful work with University of Texas (UT) technology spinoffs. The institute operates the Austin Technology Incubator, which has worked with the University and economic partners in the Austin area during the last few years to create new companies and jobs from research work performed at UT.

The IC2 Institute has developed a laboratory-to-market model which specializes in technology incubation – taking the technological output of a laboratory, in this case JSC and Ames, and pairing that technology with appropriate partners in the business and financial community to create and foster new industry and with the industry, new jobs.

- more -

The IC2 will work during the 3-year grant period to forge firm links between the two NASA centers and community and economic resources in the Bay Area and in Southeastern Texas. The goal of this project is to accelerate the technology commercialization process and to bolster the entrepreneurial spirit throughout NASA. Both Ames and JSC will have separately-operated "incubators," with staff provided by the IC2 Institute.

The NASA goal is to shorten the learning curve associated with successfully commercializing technology from NASA to the private sector and to reduce the time required for this transfer to take place. IC2 will be working directly with individuals at both centers to foster financial support and community resources which might be required to bring a NASA-developed technology to the commercial market.

In Houston much of the expected technology commercialization will involve medical science and aerospace research because of JSC's role as the manned space center and because of the Houston area's position as a world-leader in medical technology and the emerging role of Houston in the aerospace field. For Ames the focus is expected to be computing skills and hardware, materials and selected medical areas and the capabilities of the Silicon Valley to support and commercialize that type of technology.

The two centers represent dramatically different types of technology development and reside in strongly different economic and social regions. As a result of these differences, NASA's Office of Advanced Concepts and Technology expects that if the experimental commercialization centers at Ames and JSC are successful, this concept could be extended to other NASA centers and could be used as models for other federally-funded laboratories.

The cooperative agreement with the University of Texas, IC2 Institute, calls for about $400,000 funding for each of the two centers this year, with funding rising to approximately $1 million a year at each of the centers for 1994 and 1995. Total program funding is $5.4 million over the 3-year life.

- end -

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For Release
February 25, 1993

RELEASE: 93-038

GOLDIN ANNOUNCES KEY SPACE STATION POSTS, SPENDING MEASURES

NASA Administrator Daniel S. Goldin has named Dr. Joseph F. Shea to oversee the redesign of the Space Station and has provided new policy direction for Space Station contract cost management during the design transition.

Shea has been appointed Assistant Deputy Administrator of the agency and will be directly responsible for leading NASA's efforts to develop options for the redesign of the Space Station, its mission and management structure.

A candidate also will be named, shortly, to establish and chair a blue ribbon panel of outside experts to review and assess NASA's redesign concept and approach.

"I have asked Joe Shea to come back to NASA to head the redesign effort. He has recently been serving as the Acting Chair of the NASA Advisory Council and brings a wealth of knowledge and experience to this critical task," Goldin said.

"Joe will be responsible for assembling a team that will involve a variety of individuals from across NASA and our international partners and will call upon the expertise of individuals both within and outside of the government and academia. The NASA/contractor Space Station team also will be called upon and Joe will work with Dick Kohrs to assure access and insight to ongoing program activities. This team will truly reflect the cultural diversity of the agency and country," Goldin added. Kohrs is Director of the Space Station Program Office.

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Goldin also announced agency-wide measures to conserve resources and restrict new spending during the redesign transition. In general, no new awards or new work modifications which relate to the current Space Station program, including support service contracts, will be solicited or issued. Work on existing contracts is not to be accelerated and Space Station contractors are being advised to discontinue overtime and any further staffing increases.

An adjunct professor of aeronautics and astronautics at the Massachusetts Institute of Technology, Shea has served on the NASA Advisory Council for several years. His contributions in the field of space flight also include 5 years with NASA in the 1960's as Deputy Director of Manned Space Flight and as Apollo Program Manager at the NASA Manned Spaceflight Center, Houston (now the Johnson Space Center). He also served as Manager of the Titan inertial guidance program for General Motors Corp. and is a retired senior vice president of the Raytheon Co.

Shea has served on the Defense Science Board and the National Research Council, is a member of the National Academy of Engineering and is a former President of the American Institute of Aeronautics and Astronautics.

- end -

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For Release
February 26, 1993

SPACE SHUTTLE MISSION STS-55 LAUNCH ADVISORY

NASA managers today set March 14, 1993 as the launch date for Shuttle Mission STS-55 which will see Space Shuttle Columbia and her 7 member crew fly a mission dedicated primarily to the German Space Agency.

The major payload for STS-55, the pressurized module Spacelab-D2, will allow the astronauts to conduct a wide range of experiments in the microgravity environment of spaceflight. Some 90 experiments are planned.

This launch advisory follows the removal, inspection and replacement of the high pressure oxidizer turbopumps on Columbia's three main engines. The pump changeout came after a search of processing paperwork could not determine conclusively that the pumps were equipped with a newer version of turbine tip seal retainers. The seals minimize the flow of gas around the tips of the turbine blades to enhance pump performance, and the retainers hold the seals in place.

The launch window on March 14 opens at 10 a.m. EST. Following launch, Columbia's crew will be divided into two teams, each working a 12-hour shift, so that science operations can be carried out around the clock. The Spacelab D2 mission duration is scheduled for 9 days. Landing is planned for Kennedy Space Center's Shuttle Landing Facility.

- end -

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 453-8400

ISY

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Headquarters, Washington, D.C.
(Phone: 202/358-1778)

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Johnson Space Center, Houston
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For Release
February 26, 1993

EDITORS NOTE: N93-9

COSMONAUTS TO MEET THE PRESS

Russian cosmonauts Col. Vladimir G. Titov and Sergei K. Krikalev will meet with media representatives for interviews on Tuesday, March 9, 1993, between 9:30 a.m. and12:30 p.m. EST. Interviews will be conducted in Bldg. 2 at the Johnson Space Center, Houston.

The two cosmonauts are training as mission specialists for Shuttle mission STS-60 set for flight in late 1993. One cosmonaut will be designated as the prime crew member with the other serving as his backup.

During the STS-60 mission, the crew will deploy and retrieve the Wake Shield Facility to test the creation of an ultra-vacuum in which to produce extremely pure thin film crystals for industrial uses ranging from microelectronics to lasers and superconductivity. The mission also will include a number of microgravity experiments in Spacehab 2, as well as U.S. and Russian Space Agency life sciences investigations.

Along with the cosmonaut mission specialists, STS-60 Commander Charles Bolden, Pilot Ken Reightler and mission specialists Jan Davis, Franklin Chang-Diaz and Ron Sega will be available for interviews about the mission's experiments and payloads.

Media desiring to participate in the interviews should contact Billie Deason at 713/483-5111 no later than 6 p.m. EST, Friday, March 5.

- end -

NASA News
National Aeronautics and
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Washington, D.C. 20546
AC 202 358-1600

For Release

Brian Dunbar
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

February 26, 1993

Mary Hardin
Jet Propulsion Laboratory, Pasadena, Calif.
(Phone: 818/354-5011)

RELEASE: 93-39

SCIENTISTS FORESEE STRENGTHENING EL NINO EVENT

Scientists studying data from the U.S.-French TOPEX/POSEIDON oceanographic spacecraft have observed an ocean phenomena in the equatorial Pacific that will strengthen the ongoing El Nino event off the western coast of South America.

The scientists have been analyzing a prominent Kelvin wave that has appeared in recent TOPEX/POSEIDON altimeter data. A Kelvin wave is a large warm water mass that moves along the Equator in the Pacific Ocean. These Kelvin wave pulses give rise to El Nino conditions in the eastern equatorial Pacific. The Kelvin wave pulse seen in the TOPEX/POSEIDON data also was predicted by the global ocean numerical models developed on supercomputers at the Naval Research Laboratory, Washington, D.C.

The Kelvin wave pulse was excited by westerly wind anomalies in the western Pacific in December 1992 and is projected to arrive at the South American coast in late February or early March. The satellite data indicates an arrival in the early part of the window, while the Navy model points to a slightly later date. The imminent arrival of this Kelvin wave pulse suggests that the current warm conditions in the western Pacific will continue or possibly intensify during March.

The strengthening of the El Nino means that the weather conditions associated with it are likely to continue said Dr. Jim Mitchell of the Naval Research Laboratory. These conditions include wetter than normal weather in California, wetter and colder winters than normal in the eastern United States and warmer and dryer summers than normal across the southern hemisphere.

- more -

Launched Aug. 10, 1992, TOPEX/POSEIDON also is addressing long-term climate issues. By mapping the circulation of the world's oceans over several years, scientists can better understand how oceans transport heat, influence the atmosphere and affect long-term climate, said Dr. Lee-Leung Fu of the Jet Propulsion Laboratory (JPL), Pasadena, Calif. Dr. Fu is the TOPEX/POSEIDON Project Scientist for NASA.

Data from TOPEX/POSEIDON is distributed monthly to more than 200 scientists around the world for their analysis.

TOPEX/POSEIDON is the second satellite in NASA's Mission to Planet Earth, a comprehensive research program to study the Earth's environment as a global system. JPL manages the NASA portion of the mission for the Earth Science and Applications Division of the Office of Space Science and Applications, Washington, D.C.

- end -

Billie Deason
Correction to Release No. 93-~~013~~ 9

March 3, 1993

Because of a training schedule conflict, the three STS-60 NASA mission specialists, Jan Davis, Franklin Chang-Diaz and Ron Sega, will not be available to participate in the media interviews on Tuesday, March 9 as stated in Release no. 93-013. STS-60 Commander Charles Bolden, Pilot Ken Reightler, and Cosmonauts Vladimir Titov and Sergei Krikalev will be available as planned.

The times for the interviews should read "between 8:30 and 11:30 a.m. CST" instead of 8:30 a.m. and 11:30 p.m.

- end -

NASA News

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ISY

For Release

Michael Braukus
Headquarters, Washington, D.C.
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March 4, 1993

RELEASE: 93-040

NASA SELECTS CENTER FOR LIFE SCIENCES RESEARCH

NASA has selected the University of Texas Southwestern Medical Center, Dallas, to become the NASA Specialized Center of Research and Training (NSCORT) in Integrated Physiology. NASA plans to award Southwestern Medical Center approximately $1 million a year for 5 years.

NASA made the selection from 18 applicants on the basis of merit as judged by peer review panels assembled by the American Institute of Biological Sciences.

"The Southwestern Medical Center application is comprehensive," said NASA's Chief Scientist for Life Sciences Dr. Ronald White. "It includes research that ranges from molecular biology to the study of humans. The research team assembled in Dallas is of high quality and has a clear understanding of NASA's mission," White said.

The new center will be designed to contribute a better understanding of how different organ systems of various species react to space flight. One component will deal with cellular and molecular mechanisms while other components will focus on the effects that the special conditions of space flight have on skeletal muscle, bone and minerals and the cardiovascular system. The Director of the new NSCORT is C. Gunnar Blomqvist, M.D., Professor of Medicine and Physiology at Southwestern.

The NSCORT program is an integral part of NASA's Office of Space Science and Applications Life Sciences Division's research and analysis activities to advance basic knowledge and create effective ways for solving specific problems in the space life sciences. The program was established in 1990 exclusively to support ground research and analysis in the various research specialities.

- more -

The addition of Southwestern Medical Center brings the total number of NASA-funded NSCORTs to six. The previously selected institutions include:

- o Bioregenerative Life Support - Purdue University, West Lafayette, Ind.
- o Evironmental Health - University of Rochester, Rochester, N.Y.
- o Exobiology - University of California, San Diego
- o Gravitational Biology - Kansas State University, Manhattan, Kan.
- o Radiation Health - Lawrence Berkeley Laboratory, Berkeley, Calif.

Germany also is funding a NSCORT in radiation health at the University of Giessen, Giessen, Germany.

- end -

NASA News

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ISY

For Release

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Headquarters, Washington, D.C.
(Phone: 202/358-1547)

March 4, 1993
Embargoed Until 6 P.M.

Catharine G. Schauer
Langley Research Center, Hampton, Va.
(Phone: 804/864-6122)

RELEASE: 93-41

MT. PINATUBO ERUPTION CAUSES TEMPORARY COOLING OF EARTH

Satellite observations confirm that Mount Pinatubo's eruption in June 1991 resulted in a temporary cooling of the Earth that equates to a decrease in global surface temperature of approximately 1 degree Fahrenheit (0.5 degree Celsius).

"A 1 degree Fahrenheit decrease in global temperature is significant," said Dr. Patrick Minnis of NASA's Langley Research Center, Hampton, Va. "The increase in solar radiation reflected from the Earth, responsible for this cooling, continued through October 1991 and is well correlated with the gradual spread of the Pinatubo dust cloud over the globe.

"Data show that the relative cooling produced by Mount Pinatubo is 60 percent greater than any other climate disturbance since 1976. Systematic global observation of the Earth's radiation balance began that year," said Dr. Minnis.

"Surface cooling may follow the radiative response by several months to a year, and the effect of Mount Pinatubo may be evident for some time after most of the dust cloud has settled back to the surface. Indications are that the effects of Mount Pinatubo may be felt through early 1994," he said.

Volcanic activity has been suspected of causing significant short-term climate changes. Powerful volcanic eruptions typically send huge quantities of gases and ash into the stratosphere. The gases and ash produce aerosols that block incoming sunlight, which can have an effect for many years.

Analysis of measurements from NASA's Earth Radiation Budget Experiment (ERBE) satellite has provided the first conclusive evidence of a significant change in global energy due to a volcanic eruption.

- more -

ERBE satellite measurements provide the data needed to understand the link between volcanic dust and temperature changes at the Earth's surface. The gases and ash ejected by volcanos can penetrate into the stratosphere from 7 to 30 miles high (11.2 to 48 kilometers), where the debris may form a dust veil that spreads over the globe and slowly filters down to the surface over several years.

The dust veil reflects some of the sun's rays back to space, thus cooling the Earth's surface. But volcanic dust also can produce a greenhouse warming effect by trapping the infrared rays emitted by the Earth. The net effect ultimately determines changes in the surface temperature.

Whether the dust cloud cools or warms the Earth and by how much depends on the concentration, sizes and shapes of the particles in the dust cloud. Because the latter two quantities are difficult to estimate, climate computer-model predictions are subject to potentially large uncertainty.

Heating and cooling of the Earth is determined by the balance between absorbed solar radiation and emitted infrared radiation. Solar radiation that is not reflected by clouds, the atmosphere or the surface, is absorbed and causes the Earth to warm. The emitted infrared radiation cools the Earth by carrying heat away from the planet.

ERBE directly observes changes in the emitted infrared and reflected solar radiation and enables scientists to match the radiation changes in their predictions with ERBE data.

Launched in 1984, ERBE is one of the precursor missions in NASA's long-term Mission to Planet Earth program for studying climate change. The ERBE instruments were developed at NASA's Langley Research Center, Hampton, Va., and the TRW Corp., Redondo Beach, Calif. Langley is responsible for data analysis.

The results of a study by NASA researchers on "Radiative Climate Forcing by the Mount Pinatubo Eruption" will be published in the March 5 issue of Science.

-end-

EDITORS NOTE: A computer-generated graphic depicts ERBE satellite results showing how the aerosols affect incoming solar energy. The graphic can be obtained by calling 202/358-1741. Color: 93-HC-77 B&W: 93-H-84

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For Release
March 5, 1993

MEDIA ADVISORY

SPACE STATION UTILIZATION CONFERENCE TO BE RESCHEDULED

The Space Station Freedom Utilization Conference, planned for June 21-24 in San Francisco, Calif., has been postponed. A new date for the conference has not been set.

NASA managers decided to postpone the conference because of recent direction to redesign the space station.

The first user conference was held in 1992 in Huntsville, Ala. The conference is intended to inform scientists from academia, industry and government about the space station's research plans and capabilities.

-end-

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Barbara Schwartz
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March 5, 1993

RELEASE: 93-42

STS-62 AND STS-59 SPACE SHUTTLE CREW ASSIGNMENTS ANNOUNCED

NASA today named the crews of STS-62 and STS-59, two Space Shuttle missions scheduled for launch in early 1994.

USAF Colonel John H. Casper will command the STS-62 mission with the second U.S. Microgravity Payload and the second Office of Space and Terrestrial Applications payload, called OAST-2, aboard Columbia. Other crew members are USMC Major Andrew M. Allen as Pilot and mission specialists USN Commander Pierre J. Thuot, USA Lt. Colonel Charles D. "Sam" Gemar and Marsha S. Ivins.

Experiments on STS-62, a 13-day extended duration orbiter mission, include growing crystals of semiconductor materials; investigating the properties of xenon during phase transitions, investigating the fundamental behavior of materials as they solidify into structures known as dendrites and monitoring equipment that will measure and record disturbances in the microgravity environment of the USMP carrier. These experiments allow the scientific and commercial communities to test space-based processes for beneficial applications here on Earth.

USAF Colonel Sidney M. Gutierrez will command the STS-59 Space Radar Laboratory mission aboard Atlantis. Other crew members are USAF Colonel Kevin P. Chilton as Pilot and mission specialists Jay Apt, Ph.D., and Michael R. "Rich" Clifford, USA Lt. Colonel. Previously announced crew members are Linda M. Godwin, Ph.D., named Payload Commander in August 1991 and Thomas D. Jones, Ph.D., named mission specialist in February 1992.

- more -

The Space Radar Laboratory, STS-59, will take radar images of the Earth's surface for Earth system sciences studies including geology, geography, hydrology, oceanography, agronomy and botany; gather data for future radar system design including the Earth Observing System, and take measurements of the global distribution of carbon dioxide in the troposphere.

Casper, 49, commanded STS-54 in January 1993, a mission to deploy a Tracking and Data Relay Satellite. He was Pilot on STS-36 in February 1990, a DOD flight. Casper was born in Greenville, S.C., but considers Gainesville, Ga., his hometown. He received a bachelor of science degree in engineering science from the U.S. Air Force Academy in 1966 and a master of science degree in astronautics from Purdue University in 1967.

Allen, 37, was Pilot on STS-46, an 8-day mission to deploy the European Retrievable Carrier (EURECA) and to demonstrate the Tethered Satellite System (TSS) launched in July 1992. Allen was born in Philadelphia, Penn., and received a bachelor of science degree in mechanical engineering from Villanova University in 1977.

Thuot, 37, was mission specialist on STS-36, a DOD mission launched in February 1990. He also was mission specialist and one of the spacewalking crew members on Endeavour's maiden voyage to retrieve, repair and reboost the Intelsat communications satellite. Thuot was born in Groton, Conn., but considers Fairfax, Va., and New Bedford, Mass., his hometowns. He received a bachelor of science degree in physics from the U.S. Naval Academy in 1977 and a master of science degree in systems management from the University of Southern California in 1985.

Gemar, 37, was a mission specialist on STS-38, a DOD mission in November 1990, and STS-48 in September 1991 to deploy the Upper Atmosphere Research Satellite which studied the winds, chemistry and energy particles in Earth's upper atmosphere. emar was born in Yankton, S.D., but considers Scotland, S.D., his hometown. He graduated with a bachelor of science degree in engineering from the U.S. Military Academy in 1979.

Ivins, 41, was mission specialist on STS-32 in January 1990, an 11-day flight during which the crew deployed a communications satellite and retrieved the Long Duration Exposure Facility, and STS-46, the EURECA/TSS mission. Ivins was born in Baltimore, Md., and received a bachelor of science degree in aerospace engineering from the University of Colorado in 1973.

Gutierrez, 41, was Pilot on STS-40 Spacelab Life Sciences-1 in June 1991. Born in Albuquerque, N.M., Gutierrez received a bachelor of science degree in aeronautical engineering from the U.S. Air Force Academy in 1973 and a master of arts degree in management from Webster College in 1977.

Chilton, 38, was Pilot on STS-49, the Space Shuttle Endeavour's maiden flight in May 1992. He was born in Los Angeles, Calif. Chilton graduated with a bachelor of science degree in engineering sciences from the USAF Academy in 1976 and received a master of science degree in mechanical engineering from Columbia University on a Guggenheim Fellowship in 1977.

Apt, 43, was mission specialist and a spacewalking crew member on STS-37 in April 1991, a mission to deploy the Gamma Ray Observatory and to test concepts and gather engineering data on the forces a crew member can exert on bolts and equipment in preparation for assembling Space Station Freedom. Apt was the flight engineer on STS-47. He was born in Springfield, Mass., but considers Pittsburgh, Penn., his hometown. Apt graduated magna cum laude with a bachelor of arts degree in physics from Harvard College in 1971 and received a doctorate in physics from the Massachusetts Institute of Technology in 1976.

Clifford, 40, flew as a mission specialist on STS-53 in December 1992, a DOD flight, during which Clifford operated a fluid transfer experiment and a laser detector to acquire transmissions from low-power Earth-based lasers. He was born in San Bernadino, Calif., but considers Ogden, Utah, his hometown. Clifford received a bachelor of science degree from the U.S. Military Academy in 1974 and a master of science degree in aerospace engineering from the Georgia Institute of Technology in 1982.

- end -

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FOR RELEASE: March 5, 1993

RELEASE: 93-043

ASTRONAUT JEMISON TO LEAVE NASA

Mae C. Jemison, M.D., announced that she will leave NASA March 8 to pursue interests in "teaching, mentoring, health care issues and increasing participation in science and technology of those who have traditionally been left out."

"I leave with the honor of having been the first woman of color in space, and with an appreciation of NASA--the organization that gave me the opportunity to make one of my dreams possible. The experiences of the NASA astronaut program have opened many doors, and provided a way to put my hard work and training to use for the good of others," said Jemison.

Jemison, 36, was selected for the astronaut program in June 1987. She was a science mission specialist on STS-47, Spacelab-J, in September 1992, a cooperative mission with the Japanese to study life sciences and materials processing. Jemison was a co-investigator on the bone cell research experiment flown on that mission.

Jemison earned a bachelor of science degree in chemical engineering from Stanford and a doctorate degree in medicine from Cornell. Her work experience included medical research, a stint as Area Peace Corps Medical Officer for Sierra Leone and Liberia in West Africa, and a physician for a nation-wide health care organization.

"Mae is an outstanding role model. We are sorry to see her go. I am certain that in our future recruiting efforts we will be able to welcome to the astronaut corps talented young scientists and engineers who have been inspired by Mae's accomplishments. We wish her continued success in whatever she pursues," director of Flight Crew Operations David C. Leestma said.

- end -

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ISY

Mark Hess
Headquarters, Washington, D.C.
(Phone: 202/358-1776)

For Release
March 10, 1993

MEDIA ADVISORY

SPACE STATION REDESIGN MEDIA BRIEFING RESCHEDULED

The press briefing originally scheduled for Thursday, March 11, at 1 p.m. EST, has been rescheduled for 3 p.m. EST.

NASA Administrator Daniel S. Goldin will discuss details of the space station redesign process. He will be joined by Arnold Aldrich, Associate Administrator for Space Systems Development, and Bryan O'Connor, Deputy Associate Administrator for Space Flight. NASA center directors will be in attendance.

The press briefing will be carried live on NASA Select television from the auditorium located on the lobby level of the new NASA Headquarters building, 300 E Street, S.W., Washington, D.C.

- end -

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For Release

Michael Braukus
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

March 11, 1993

Jerry Berg
Marshall Space Flight Center, Huntsville, Ala.
(Phone: 205/544-0034)

LAUNCH ADVISORY

NASA TETHERED PAYLOAD TO BE LAUNCHED BY AIR FORCE

The first flight of NASA's Small Expendable-tether Deployer System (SEDS) is scheduled to be launched aboard a U.S. Air Force Delta 2 rocket from Cape Canaveral Air Force Station, Fla., no earlier than March 18. The SEDS tether system will be a secondary payload on the Delta 2 launch vehicle.

The launch window opens 10:55 p.m. and extends until 11:22 p.m. EST, if the launch occurs on March 18, according to Air Force officials. The tether deployment process is planned to begin about 60 minutes after the Delta 2 launch and end approximately 1 hour and 40 minutes later.

SEDS is intended to demonstrate a low-cost method for using a tether to deploy small payloads, such as satellites, to higher orbits or downward toward Earth's atmosphere. It also is being flown to expand the limited amount of existing data on the dynamics of tethered bodies in space.

- end -

EDITORS NOTE: A written status report concerning the outcome of the SEDS demonstration will be distributed by fax following the completion of the SEDS mission. Media wishing to receive the status report should provide a fax number to the Media Services office at the Marshall Center by calling 205/544-6540 or -0034.

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For Release

Jeff Carr
Headquarters, Washington, D.C.
(Phone: 202/358-1826)

March 11, 1993
3 P.M. EST

RELEASE: 93-044

ORGANIZATIONAL CHANGES TO ENHANCE PROGRAMS, RELATIONS

A series of organizational changes to improve the focus on programs and enhance external relationships were announced today by NASA Administrator Daniel S. Goldin.

In a move to strengthen the top-level management of the agency, Goldin has named John R. Dailey as Acting Deputy Administrator. Dailey has been serving as Associate Deputy Administrator since November 1992 after retiring from a highly distinguished 36-year career in the Marine Corps.

The Administrator also announced that Dr. Joseph Shea, recently named as Assistant Deputy Administrator for Space Station Analysis, will have oversight of all Space Station related development activities.

The organizational changes particularly target NASA science and exploration programs and the agency's relations with American industry, academia, government and non-government laboratories, and international partners. "Science and exploration are what NASA is all about," the Administrator said. "These changes will re-establish that focus."

New program offices for Life and Microgravity Sciences and Applications and for Advanced Concepts and Technology have been formally established and will report directly to the Administrator.

The official formation of the Office of Planetary Science and Astrophysics and the Office of Mission to Planet Earth also are being implemented effective this date. The plan to form these offices out of the former Office of Space Science and Applications was announced in October 1992.

- more -

Named as Associate Administrator for Life and Microgravity Sciences and Applications is Dr. Harry C. Holloway, Deputy Dean of the Uniformed Services University of the Health Sciences, Bethesda, Md. Dr. Holloway has performed extensive study into the impact of extreme environments on human adaptation. He has been Chairman of the NASA Aerospace Medicine Advisory Committee since 1988 and a member of NASA's U.S./U.S.S.R. Joint Working Group on Space Biology and Medicine.

Assisting Dr. Holloway in setting up this new organization will be Dr. Bonnie J. Dunbar, a NASA astronaut since 1981. Dr. Dunbar is a veteran of three space flights which logged more than 761 hours in space. Her most recent flight was STS-50, June 25-July 9, 1992, on which she was Payload Commander of the first U.S. Microgravity Laboratory mission. She received her doctorate in Biomedical Engineering from the University of Houston in 1983 and a master of science degree in Ceramic Engineering from the University of Washington in 1975.

Dr. Arnauld E. Nicogossian will become Deputy Associate Administrator for Space Flight Activities, Life and Microgravity Sciences and Applications. He is presently Chief Medical Officer in NASA's Office of Space Flight and has been with NASA since 1972.

In announcing the new organization for Life and Microgravity Sciences and Applications, Goldin said it is critical to the President's stated objective for a strong and productive space program, which includes development of a space station.

Goldin said, "The President wants the current space station redesigned as part of a program that is more efficient and effective, and capable of producing greater returns on our investment. The redesigned space station must provide for significant long duration space research in materials and life sciences during this decade."

"To assure the right emphasis in the redesign effort and also within NASA," Mr. Goldin said, "I am elevating Life and Microgravity Sciences and Applications to report directly to the Administrator, and I am bringing all of the elements together into a strong organization."

The decision also was recommended in a NASA study led by Roy Estess, Director of Stennis Space Center, Miss., which reviewed the agency's life sciences activities. "Applications is also a key element of this new organization," the Administrator said, "because providing benefits here on Earth must be an important consideration."

The Administrator also pointed out that, "turning back the pages of NASA's history, the agency's greatest scientific research in life sciences was during the Skylab program, in which there was a similar emphasis placed on the activity in an organizational sense."

Dr. Wesley Huntress will become Associate Administrator for Planetary Science and Astrophysics. He was named as acting in that position in October and previously had been Director of the Solar System Exploration Division since 1990. Prior to joining NASA in 1988, he had a distinguished 20-year career at the Jet Propulsion Laboratory, Pasadena, Calif.

The new Mission to Planet Earth (MTPE) Office will be headed by Dr. Shelby G. Tilford, named as the Acting Associate Administrator. The MTPE office will consist of divisions for flight systems, for operation, data and information systems, and for science.

The Administrator also has taken measures to strengthen NASA's space programs and the commercialization of technology.

The Office of Advanced Concepts and Technology has been formally established with Gregory Reck as Acting Associate Administrator. Reck served as Director of the Space Technology Program at NASA Headquarters before his selection to this post and has over 20 years experience in technical research, management and oversight of various technology programs.

In the Office of Aeronautics, Dr. Kristin A. Hessenius has been named as Deputy Associate Administrator. She has been the Director of Aeronautical Research in the Office of Aeronautics. Prior to coming to NASA Headquarters, Dr. Hessenius was Deputy Director of Aerophysics at NASA's Ames Research Center, Mountain View, Calif. In 1992, she was one of 10 women honored by the National Aviation Club for outstanding contributions to the field of aviation.

Goldin has named Deidre A. Lee as Associate Administrator for Procurement. She has been acting in that position since early January and had been Deputy Associate Administrator of Procurement since September 1992. She has an extensive background in a variety of military and government procurement positions. Procurement reform is a vital element in NASA's new management approach.

- end -

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For Release

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March 15, 1993

Linda Ellis
Lewis Research Center, Cleveland
(Phone: 216/433-2899)

RELEASE: 93-45

CATARACT SUFFERERS COULD BENEFIT FROM SPACE TECHNOLOGY

Thousands of potential cataract sufferers may benefit from technology development now underway by researchers at NASA's Lewis Research Center, Cleveland, Ohio. A recently developed, Lewis diagnostic tool may lead to treatment of cataracts while they are in the early formative stages.

According to Dr. Rafat Ansari, project scientist at the Lewis center, "Once a series of voluntary patient studies is completed using this prototype tool, pharmaceutical companies then may have the opportunity to develop the necessary drugs to neutralize a developing cataract."

The tool is a small, fiber optic probe that can detect protein crystals suspended in the fluid inside the eye's lens. These crystals are suspected of forming into a cloudy mass over time, thus causing cataracts.

"Until now," according to Ansari, "physicians have not had the technology to tell what is really happening inside the lens." Along with Professor Harbans Dwadwal of the State University of New York at Stoneybrook, Ansari has developed an instrument that uses laser light to detect cataracts in the very early formative stages.

An optical fiber transmits a low-power laser beam which is scattered inside the eye with the reflections picked up by a return fiber optical path. The reflected light returned through the optical path is sampled by a light detector inside the small device. The laser light is very weak so there is no risk to eye damage from the laser.

The electrical signal from the detector is fed to a laptop computer where it is analyzed and where it also could be stored permanently. A change in protein particle size might indicate the onset of a cataract.

- more -

Ansari points out that fiber optic probes also can measure the sizes of very small particles that are suspended in solutions. This capability may have use in industrial applications as well as in the field of ophthalmology.

Originally developed for an experiment in materials processing aboard the Space Shuttle, the diagnostic tool is small enough to fit in a shirt pocket.

Ansari is a research professor at Cleveland's Case Western Reserve University who works as a project scientist for the Lewis Research Center under a Case Western Reserve-NASA cooperative research program. He currently is assigned to Lewis' Materials Division.

- end -

EDITORS NOTE: Line drawings to illustrate this release are available to news media representatives by calling 202/358-1741.

B&W: 93-H-85 and 93-H-86

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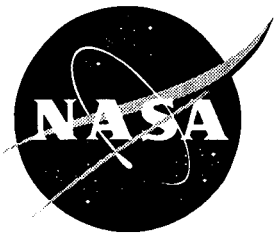

For Release

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March 16, 1993

Michael Mewhinney
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(Phone: 415/604-9000)

RELEASE: 93-46

NASA, LEARJET JOIN TO CREATE NEW BUSINESS JET TECHNOLOGIES

NASA and Learjet Inc., Wichita, Kan., will work together on new technologies and design methods for the development and test of a new high performance business jet.

Under a recently-signed agreement, NASA and Learjet engineers will study aircraft size and aerodynamics to create a sleek, economical plane using state-of-the-art supercomputers and wind tunnels at NASA's Ames Research Center, Mountain View, Calif.

"We are being strongly encouraged to develop research and technology programs in cooperation with the aerospace industry that will contribute to the advancement of commercial aviation. This project is a good example of that effort," said Ames project manager John Gallman. "The computer tools especially will let us take a much more creative approach to aircraft design."

The first year of the joint research program will cost about $2 million for development and testing of a wind tunnel model. NASA will contribute wind tunnel time totaling 480 hours. Learjet will build the model and will cover the costs for developing and flight testing a prototype aircraft if the test results are commercially viable. Tunnel tests are scheduled to begin in January 1994.

Both Learjet and NASA will benefit from technology transfer during this cooperative research project. "This is an opportunity to work with an American company from one end to the other of that process with feedback all the way," said Robert Kennelly, leader of Ames' Transonic Wing Design Group.

- more -

"We bring our facilities, people and expertise to the table," Kennelly added. "Learjet brings the wind tunnel model, the flight test vehicle and their expertise. They learn from us while we're learning from them."

NASA and Learjet will share test data, computer programs and design methods during the cooperative effort. Any new design methods that result will be offered to all U.S. aerospace companies.

Team members plan to include modern airfoils in their designs to reduce "drag" caused by weak shock waves that form on a wing's upper surface as an aircraft approaches the speed of sound. Airfoils are curved or flat parts of a wing that help control an aircraft and generate lift by reacting with the air as it passes the wing.

Engineers also hope to reduce the aircraft's skin friction drag by using a "laminar flow" wing design. The thin sheet of air brushing the aircraft's surface is called a boundary layer. A laminar (smooth) boundary layer reduces the friction caused when air rubs the wing surface.

The NASA-Learjet project also will try to incorporate structures that will produce a minimum weight airframe design. The combination of wings with low drag and lightweight structures should produce an economical, fuel efficient aircraft.

The project is part of NASA's basic research program in subsonic aircraft technology. The program's goal is to develop and prove better design methods for swept-wing transport aircraft such as Learjet's proposed new business jet.

- end -

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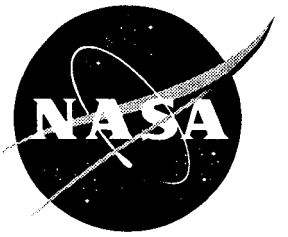

For Release

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March 16, 1993

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RELEASE: 93-47

NASA AND CENTRAL AMERICA WILL EXPAND RAIN FOREST STUDIES

NASA and the seven Central America nations have begun a program to study, preserve and protect the region's rain forest by expanding the use ofsatellite data by Central American scientists.

Under an agreement with the Central American Commission for Environment and Development, NASA will train and provide equipment to scientists from Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama.

Using data from the Advanced Very High-Resolution Radiometers flying aboard several U.S. weather satellites, the scientists will be able to estimate the amount and type vegetation cover and forest cover in the region and to conduct coastal studies.

Tropical rain forests have become an international concern because of their important but poorly understood role in the global environment. The satellite data will allow scientists to study land cover and estimate vegetation indexes. Using this data, they will be able to better understand the state of the ecosystem and estimate the area's biological productivity.

The rain forests also are home to a larger proportion of the Earth's plant and animal species than any other ecological system. Protecting this wide range of life, called biodiversity, has become another environmental concern. Many tropical plants and animals produce chemicals that are useful in medicine and other industries. The new program will enable scientists to map the extent and structure of some of these species' habitat.

- more -

The commission became interested in teaming up with NASA because of the work of Dr. Tom Sever of NASA's Stennis Space Center, Miss., and Dan Lee of Sverdup, a NASA contractor. Sever has pioneered the use of NASA remote-sensing technology to assist his research in archaeology. Realizing the capabilities of this technology, the commission entered into an agreement with NASA.

NASA will provide training, computer equipment, software and remote-sensing imagery to the commission. Four commission members spent two weeks in January at Stennis in intensive training. By transferring remote-sensing technology directly to the commission, NASA is providing nations with a vested interest in the rain forest with the means to monitor it.

"Stennis Space Center has amassed a considerable inventory of remote-sensing images of the tropical forest region in Central America," said Sever. "Not only are the images stored at Stennis, but the technology also is here to process the data.

"So what do we do with this information? With the help of other experts in forestry and soils, we could process the data and provide the commission the finished product. But we're taking that a step further and giving the commission the tools to keep this alive."

The remote-sensing data will be used to complement research on the ground and for computer analysis. Guatemala recently declared a 14,000-square-mile expanse of tropical forest and savannah in the country's northeast to be a reserve. Techniques developed in Sever's study will be part of the monitoring policy and management of the resources of the reserve.

"You can do many things with remote sensing technology that just can't be done in the field or would take a long, long time," said Sever. "The technology has given us a way to monitor the region as it has never been done before."

In addition to environmental concerns, the rain forest data will play a role in protecting the cultural sites of the ancient Mayan civilization. As forests are cut down, archaeological sites are exposed to looters. The commission was formed to preserve the archaeological and environmental importance of the region, while allowing the governments to make informed decisions about development, settlement and tourism in the area.

"It's crucial to know what happened to the Mayans and to understand how they successfully managed the delicate tropical forest economy," said Sever. "But then again, the Mayan archaeological sites are the key to the area's tourism. An infrastructure must be created to protect this Central American region and to steer development into areas that would be harmed the least."

In 1993, NASA will provide between $40,000 and $50,000 through its Earth Science and Applications Division, which also manages the agency's Mission to Planet Earth. The balance between environmental and economic concerns in the Central American rain forest echoes the central mission of Mission to Planet Earth, a comprehensive program to study the global environment that will provide governments with the information needed to make informed environmental policy decisions.

The international agreement with the commission parallels another aspect of Mission to Planet Earth: international cooperation among scientists. When the Earth Observing System Data and Information System becomes operational later in the decade, scientists from all nations taking part in Mission to Planet Earth will have access to data from all Mission to Planet Earth programs.

International scientific cooperation should lead to international cooperation on environmental issues, said Dr. Shelby G. Tilford, Acting Associate Administrator of NASA's Mission To Planet Earth Office.

- end -

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For Release

March 17, 1993

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RELEASE: 93-48

THREE SPACECRAFT TO CONDUCT 3-WEEK GRAVITATIONAL WAVE SEARCH

Three interplanetary spacecraft, now headed quietly toward Mars, Jupiter and over the poles of the sun, soon may prove the existence of elusive waves in the universe's gravitational field by bobbing on ripples in space like corks bobbing on ripples in a pond.

Such waves of gravity have never been directly detected, although their existence was predicted decades ago in Einstein's theory of relativity and there is indirect evidence that they exist. The waves are believed to be produced by supernova explosions, collapsing black holes and other catastrophic events. Past searches with ground-based equipment and single spacecraft have failed to discover them.

Astrophysicists are hoping to make this major discovery by spending the next few weeks "listening" for passing gravitational waves with three "borrowed" spacecraft at the same time in the most sensitive detection system yet assembled to search for very low frequency gravitational waves.

The spacecraft, now on their way to separate destinations in the solar system, are NASA's Mars Observer, Galileo and the European Space Agency (ESA) Ulysses spacecraft.

The joint NASA-ESA experiment will run from March 21 to April 11, marking the first time three spacecraft will make observations simultaneously, greatly increasing the reliability of any detection.

"If this experiment succeeds in detecting gravitational waves it may answer fundamental questions about the nature of gravity as well as give further support for Einstein's theory of general relativity," said Dr. Robert Stachnik, Gravitational Wave Program Scientist in NASA's Astrophysics Div., Office of Space Science, Washington, D.C.

- more -

"We're also very excited about the possibility of making a major discovery with such a cost-effective experiment. We were able to take advantage of three spacecraft already in space which soon will be in the correct relative positions and distances we need to do this experiment. We can just borrow them for a few weeks, without any added cost for equipment and no change to their missions. It's big science on a small budget," Stachnik said.

"Einstein predicted the existence of gravitational waves in his theory of general relativity, and radio astronomy observations of pulsars have suggested they indeed exist -- but no one has ever detected a gravitational wave directly," said Dr. John W. Armstrong of NASA's Jet Propulsion Laboratory, Pasadena, Calif., who will work with the Mars Observer and Galileo spacecraft.

The experiment is built around a simple concept. During the 3-week experiment, the antennas of NASA's Deep Space Network (DSN) on Earth will beam radio signals to the three spacecraft at precisely known frequencies. Each spacecraft will send signals back to Earth at the same frequency it receives. If no gravitational waves are passing through the Solar System, the signals returned to Earth should have exactly the same frequencies as the original signals sent from the DSN, shifted only by the Doppler effect of spacecraft motion.

However, if a strong enough gravitational wave passes -- produced perhaps from collapsing masses of stars in the hearts of galaxies or from the spiraling together and collision of two black holes -- both the Earth and the spacecraft will experience a slight "bobbing" from the ripple-like passage of the gravitational wave. This interaction cannot be directly detected at either the Earth or the spacecraft alone, but would show up as a slight change in the frequency of the radio signal finally received back at Earth.

The hydrogen maser clocks that control the DSN transmitters and receivers are so accurate that scientists will be able to detect a change in radio frequency of as little as a few parts in a quadrillion (a quadrillion is 1 followed by 15 zeroes).

"This should allow us to detect gravitational waves from objects such as massive pairs of black holes hidden in the hearts of other galaxies," said Hugo D. Wahlquist of JPL, who will work on the Ulysses spacecraft with Sami W. Asmar of JPL, Prof. Bruno Bertotti of the University of Pavia, Italy, and Prof. Luciano Iess of the University of Rome La Sapienza.

Scientists emphasize, however, that snaring a gravitational wave during the 3-week experiment will depend on a good bit of luck -- whether a suitable astronomical event happens to occur during the relatively brief opportunity when data can be taken. All three spacecraft will be in the Earth's night sky at that time, so interference with their radio signals due to charged particles in the solar wind will be at a minimum.

Successful detection of gravitational waves could open up an entirely new kind of astronomy. Because the gravitational waves do not readily interact with matter, detecting them may open a window to the interiors of powerful -- and sometimes catastrophic -- events such as supernova explosions and collapsing black holes.

"Gravitational wave research is now in the hands of physicists. Once signals are detected, the astronomers will be beating down the doors," said Stachnik.

Sensitive ground-based interferometer antennas now are being built in both the United States and Europe to search for gravitational waves with wavelengths of thousands of kilometers.

"In addition to searching for the shorter waves that can affect antennas here on Earth, we now will be using radio signals sent to spacecraft hundreds of millions of kilometers away to search for waves of much longer wavelength," said Dr. Frank B. Estabrook of JPL, who will work with the Galileo spacecraft.

Detection of the gravitational waves, even if they occur, will still take at least several months of patient data analysis. "The spacecraft systems can detect large enough gravitational waves, if they exist," said Dr. Bevan M. French, Program Scientist for the Mars Observer. "But it won't be one of those sudden 'Eureka!' situations. We'll be looking for a few small wiggles in a huge amount of radio data. It will take time."

To identify the unique signals of gravitational waves, the scientists also will have to eliminate such mundane effects as planned changes in the orientation of the spacecraft, interference from charged particles (plasmas) in space and even atmospheric changes, rain and snow on Earth.

Mars Observer, launched in September 1992, will reach the Red Planet Aug. 24 of this year. Launched in 1989, NASA's Galileo spacecraft will arrive at Jupiter in 1995. The ESA Ulysses spacecraft was launched in 1990, and it will fly over the sun's poles in 1994 and 1995.

Gravitational wave research is supported by the Astrophysics Division of NASA's Office of Space Science and by each of the three spacecraft projects, which scheduled the radio searches during their interplanetary cruise periods.

- end -

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Barbara Schwartz
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For Release

March 19, 1993
4 p.m. EST

RELEASE: C93-d

GE SELECTED FOR SCIENCE PAYLOADS SUPPORT CONTRACT

NASA's Johnson Space Center (JSC), Houston, has selected GE Government Services, Houston, to begin final contract negotiations for the Science Payloads Development, Engineering and Operations Contract.

Total proposed cost and fee of the 9-year effort beginning May 1, 1993, is approximately $480 million. The 9-year period of performance will be divided into a 5-year base contract period and two 2-year option periods. The space station effort will be set out as options. The award will be the continuation of the engineering and scientific effort currently being performed by GE Government Services.

The contracted work will be performed at JSC. The work to be provided includes support for dedicated life sciences missions, the biomedical monitoring and countermeasures project, small and rapid response payloads, the crew health care system and the cosmic dust collection facility.

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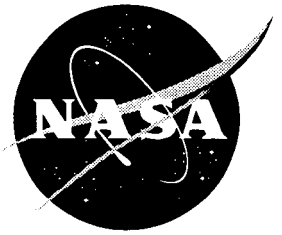

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For Release

March 19, 1993

RELEASE: 93-49

PEARSON ANNOUNCES SHUTTLE PROGRAM ADJUSTMENTS

NASA's Associate Administrator for Space Flight Jeremiah W. Pearson today announced that Leonard Nicholson is leaving his current position as Space Shuttle Program Manager to take over the key Johnson Space Center, Houston, position of Acting Director of Engineering. As a result of this action, Brewster Shaw, currently Deputy Director Space Shuttle Operations will take over the duties formerly performed by Nicholson in the position of Director Space Shuttle Operations.

JSC Director Aaron Cohen has assigned current Director of Engineering Henry Pohl to a new position on his staff, where he will be responsible for leading JSC's support of the agency's effort to redesign the space station. Pohl will spearhead the center's efforts and serve as a focal point for JSC support to Assistant Deputy Administrator Joseph Shea, who was appointed by NASA Administrator Daniel S. Goldin to oversee the redesign.

Shaw will move from Kennedy Space Center to JSC. In addition to his current duties, he will direct the day-to-day management and execution of the Shuttle program, including detailed program planning, scheduling and Shuttle systems configuration management.

As Acting Director of Engineering at JSC, Nicholson will be responsible for managing the work of eight functional divisions and providing support to program and project offices for current and future space flight programs assigned to JSC, including the Shuttle and space station. JSC's Engineering Directorate also performs complete in-house design, development and testing of certain Government-furnished equipment and maintains expertise in test facilities and computational complexes.

- more -

JSC Flight Crew Operations Director David Leestma has appointed Astronaut Linda Godwin, Ph.D. to replace Col. Loren Shriver as Deputy Chief of the Astronaut Office. Shriver is being reassigned to the Space Shuttle Program Office to assist in the management of this program.

"I'm very pleased to make these appointments" said Pearson. "These are extremely talented individuals whose knowledge and experience in space flight make them excellent choices for these key positions."

Nicholson, Shaw and Shriver are expected to assume their new duties following Shuttle Mission STS-57, in late April. Pohl will assume his new duties immediately and Deputy Engineering Director Max Engert will manage day-to-day operations of the organization until Nicholson is free to take over.

- end -

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For Release

March 22, 1993

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RELEASE: 93-50

NASA/OHIO AEROSPACE INSTITUTE TO HOST CYBERSPACE CONFERENCE

NASA's Lewis Research Center, Cleveland, and the Ohio Aerospace Institute will host a conference in Cleveland, March 30 and 31, focusing on and providing insights into the fascinating new world of Cyberspace.

Cyberspace is a metaphor coined and popularized by science fiction author William Gibson to represent the "universe" that human beings enter when they use computers.

The Vision 21 Symposium on Interdisciplinary Science and Engineering in the Era of Cyberspace conference will focus on this new metaphor and also will feature a series of speakers.

"In keeping with the conference mission to foster speculative concepts and advanced thinking in science and technology, this event will provide a panoramic view of the research and technology that will assist humans in exploration activities," said Dr. Sheila Bailey, conference Chairperson.

Bailey, who is a Lewis research physicist in the center's Power Technology Division, also said that this new vision includes "not only the Earth's environment and the Martian terrain, but the artificial reality of cyberspace."

Each of the five speakers for the conference is an interdisciplinary scientist with a unique view of the future. Together, the speakers share a common vision of cyberspace as a world where computers, robots and the human mind will be more closely linked.

- more -

The speakers include Hans Moravec from Carnegie Mellon University's Institute for Robotics, who believes that "robots with human intelligence will be common in the next 50 years."

San Diego State University mathematician and science fiction writer Vernor Vinge will talk about linking the mind and the computer. His novels explore the ethical questions associated with society's use of computers and the potential for good and evil use of these computers.

Carol Stoker, NASA Ames Research Center scientist, who uses remote sensing and telepresence in exploration activities being conducted in the Antarctic, will talk about the science and engineering challenges of using robots in the Antarctic and what might be faced in similar expeditions to the moon or Mars.

John Dalton, NASA Goddard Space Flight Center manager for NASA's Earth Observing System ground system, will discuss the use of information systems to support climate research and how global environmental models are evolving. More and more scientific analysis of Earth environment information is using scientific visualization methods which are themselves on the cutting edge of computer science. Many of the new data sets lend themselves to presentation in a "cyberspace" environment.

Dr. Myron Krueger, Director of the Artificial Reality Corp., will discuss how humans will experience and interact with or in cyberspace. Krueger termed the phrase "artificial reality" to describe human interaction with computer-generated worlds.

Attendees at the 2-day conference also will have the opportunity to tour the Ohio Aerospace Institute and the Lewis Research Center's Graphics Visualization Laboratory. That laboratory recently demonstrated distributed processing and visualization by simulating the flow of air and gasses through a turbo-jet engine - each component of which was running as a simulation on one of over 2 dozen high-powered computer workstations.

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For Release

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March 24, 1993

RELEASE: 93-51

EVIDENCE POINTS TO OCEANS, LIGHTNING ON EARLY VENUS

The last findings by the Pioneer Venus Orbiter spacecraft have provided strong new evidence that planet Venus once had three and a half times more water as thought earlier -- enough water to cover the entire surface between 25 and 75 feet deep (762 and 2286 centimeters).

These findings also give new support for the presence of lightning on Venus and discoveries about the ionosphere and top of the atmosphere of Venus. Considered Earth's twin planet, Venus today is very dry and searing hot.

Pioneer entered Venus' atmosphere on Oct. 8, 1992, and burned up soon after, ending 14 years of exploration.

"Many of us have long thought that early in its history Venus had temperate conditions and oceans like Earth's," said Dr. Thomas Donahue, University of Michigan, head of the Pioneer Venus science steering group.

"Findings that Venus was once fairly wet does not prove that major oceans existed, but make their existence far more likely," he said. "The new Pioneer data provides evidence that large amounts of water were definitely there," said Donahue.

"Most scientists think Venus' early oceans vaporized and 'blew off' 3 billion years ago in a runaway greenhouse effect when the cool early sun increased its luminosity and heated the planet very hot," he said. "The oceans evaporated. Solar ultraviolet radiation split the water molecules into hydrogen and oxygen, and the hydrogen was lost to space.

- more -

"Pioneer Venus Probe and Orbiter data showed early in the mission," Donahue said, "that on Venus heavy hydrogen (deuterium) is 150 times more abundant relative to ordinary hydrogen than on Earth and everywhere else we've looked in the solar system -- Mars, Comet Halley, meteorites, Jupiter and Saturn." Venus' remarkable hydrogen/deuterium ratio has since been confirmed by independent measurements.

Abundant deuterium is taken as clear evidence that Venus once had 150 times as much water in its atmosphere as today, he said. This is because the water's ordinary hydrogen has escaped. But most of the water's heavy hydrogen (deuterium - twice as heavy as hydrogen) stayed behind because of its weight.

When the Orbiter made its final descent to unexplored regions only 80 miles (129 kilometers) above Venus' surface, it found evidence for 3.5 times as much water as previously suggested by the deuterium ratio.

"We found a new and important easy-escape mechanism, which accelerates hydrogen and deuterium away from the planet," he said. "This means that much more hydrogen had to escape to build up the present high deuterium concentration. A lot more hydrogen lost means a lot more water early on," he said. "This also rules out theories of a dry-from-the-beginning Venus, whose present meager supply of water comes from an occasional comet impact."

The data also show that at Pioneer's lowest altitude 80 miles (129 kilometers) "whistler" radio signals, believed generated by Venus' lightning, were the strongest ever detected. Pioneer has long measured such "lightning" signals. They are the same as the radio signals used in most lightning studies on Earth.

In its final orbits, Pioneer penetrated 7 miles (11 kilometers) below the peak of Venus' ionosphere, which tends to block these radio signals. Here also, the magnetic fields which channel the signals were the strongest ever seen on Venus' night side.

"These results are best explained by a strong and persistent source of lightning in the Venus atmosphere," said Robert Strangeway of UCLA, Pioneer electric field investigator.

Some scientists continue to doubt Venus lightning. They say only optical sightings can prove lightning. A Russian spacecraft has reported visible-light sightings of lightning. Four Russian spacecraft and the U.S. Galileo craft also have observed radio signals believed from lightning.

Pioneer found the peak density of Venus' ionosphere for the first time - at 87 miles (139 kilometers). The ionosphere was much different between solar maximum and minimum, which are high and low periods of storm activity on the sun and in the solar wind. At minimum, it was far smaller. It was gone altogether above 85 miles (136 kilometers), and its lower layer was half as dense. It was more variable, much cooler, and full of small structures (1-60 miles in size (1.6-96 kilometers).

For the ionosphere on the night side, at solar minimum, hydrogen ions were reduced 20 times. Its lower layer was half as dense as at maximum.

Over 3 months, Pioneer provided data from 80 to 210 miles (129 to 336 kilometers) altitude. It found the beginning of Venus' real, mixed atmosphere (transition from oxygen to carbon dioxide) at 80 miles (129 kilometers). Below 85 miles (136 kilometers), it identified various waves and a 4-day oscillation of Venus' atmosphere top. The neutral atmosphere above 185 miles (296 kilometers) was more than 10 times denser and 2120 F (1,000 degrees Celsius) hotter than thought.

Working with Donahue were Drs. Richard Hartle and Joseph Grebowsky of NASA's Goddard Space Flight Center, Greenbelt, Md. Ames Research Center manages the Pioneer project for the Office of Space Science, NASA Headquarters, Washington, D.C.

- end -

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For Release
March 25, 1993

RELEASE: 93-52

NASA TO DEVELOP TECHNOLOGY FOR FUTURE HIGH-SPEED TRANSPORTS

NASA's Langley Research Center, Hampton, Va., will lead a multi-year, research program effort to develop technology for a future high-speed civil transport.

The joint NASA-industry effort would provide a technical foundation that the nation's aerospace companies could use to make intelligent business decisions about future supersonic transport airframe and engine development programs.

"The program is laying a technical foundation for an environmentally compatible, economically practical commercial transport that could contribute up to 140,000 jobs and $200 billion to the national economy in the next century," said Louis J. Williams, Director of the High-Speed Research Division, NASA Headquarters, Washington, D.C.

Langley will manage high-speed technology in aerodynamic performance, airframe materials and structures, flight deck systems and airframe and systems integration. And, Langley researchers are working to reduce sonic boom, reduce overall structural weight and improve aerodynamic performance.

NASA's Lewis Research Center, Cleveland, is working on technology that will reduce engine noise and dramatically lower nitrogen oxide emissions that might affect Earth's ozone layer.

NASA's Ames Research Center, Mountain View, Calif., is flying high-altitude missions to analyze the impact of a future high-speed civil transport's engine exhaust on the atmosphere.

- more -

NASA's Dryden Flight Research Facility Edwards, Calif., is flight-testing a drag-reduction concept called "laminar flow control" that could significantly improve the efficiency of a supersonic transport's wings.

The High-Speed Research Program will complete Phase I, focused on environmental challenges, in 1996. Phase II, which began in 1993, focuses on technology to provide economic viability for a high-speed civil transport.

The program's technical management is being consolidated at Langley because the center has research skills and facilities in most of the disciplines important to the success of a future high-speed airliner. W. Ray Hook has been named to head the project office.

"Hook's previous program management experience, coupled with his involvement in the Atmospheric Science Division's analysis of the potential environmental impact of a high-speed transport and his unique experience as the leader of the NASA Aeronautics Red Team, make him especially well qualified for this important leadership position," said H. Lee Beach, Acting Langley Director.

- end -

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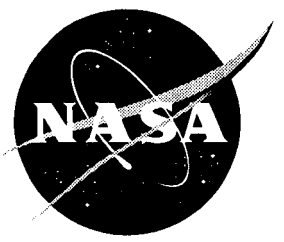

For Release

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March 24, 1993

RELEASE: 93-53

DIAZ NAMED TO SPACE SCIENCE POST

Alphonso V. Diaz was named today as the Deputy Associate Administrator for NASA's new Office of Space Science, effective immediately.

In making the announcement, NASA Administrator Daniel S. Goldin said, "Al is widely recognized as an accomplished manager. His leadership ability and technical expertise are vital as we reestablish the focus of NASA's science and exploration programs."

During his extensive career at NASA, Diaz served as Deputy Associate Administrator for Space Science and Applications, managed the Galileo and Ulysses programs in the Solar System Exploration Division and developed space science programs for Space Station Freedom.

Diaz began his NASA career at the Langley Research Center, Hampton, Va., in 1964 as a cooperative education student. Later at Langley, he worked on the technical development of one of the Viking Mars exploration experiments.

Diaz received a B.S. degree from St. Joseph's University, Philadelphia, in 1966; a M.S. degree in physics from Old Dominion University, Norfolk, in 1970; and a M.S. degree in management from Massachusetts Institute of Technology, Cambridge, as a NASA-sponsored Sloan Fellow in 1986. He was awarded the NASA Medal for Outstanding Scientific Achievement in 1977 for his work on the Viking experiment.

- end -

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For Release

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March 25, 1993

LAUNCH ADVISORY: STS-56 FLIGHT READINESS REVIEW COMPLETED

The Flight Readiness Review for the launch of STS-56/Discovery was held today with no major issues identified.

Shuttle managers will set a target launch date next week after resolution of the problem which caused last's Monday's engine shutdown on Space Shuttle Columbia.

The primary STS-56 payload, ATLAS 2, will investigate the sun's energy output and the Earth's middle-atmosphere chemical makeup and how these factors affect levels of Earth's ozone, which prevents much of the sun's harmful ultraviolet radiation from reaching the Earth's surface.

The 8-day STS-56 mission will be commanded by Kenneth Cameron and piloted by Steven Oswald. Three mission specialists will round out the five-person crew: Michael Foale, Kenneth Cockrell and Ellen Ochoa.

- end -

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For Release
March 25, 1993

RELEASE: 93-54

EXPLORATION EFFORT SHIFTED TO OFFICE OF SPACE SCIENCE

NASA Administrator Daniel S. Goldin today announced that the activities of the Office of Exploration will be absorbed by the Office of Space Science, effective immediately.

He said the change was being made in the interest of maintaining clear and well-defined management responsibilities. The exploration activitites will be focused in a new organizational unit as a division of the Office of Space Science.

"The Office of Exploration has provided a needed focus for the agency's vision of the future," Goldin said. "But it is only practical that further studies on human expeditions to the moon and Mars complement and build on the more near-term robotic missions."

Associate Administrator for Exploration, Dr. Michael D. Griffin, has been reassigned as the agency's Chief Engineer.

"Dr. Griffin and his organization have served NASA well in charting a course for the future," said Goldin. "The redesigned space station and our robotic missions are the beginning and must be our priority tasks in the near term."

The Office of Space Science was created as part of a series of organizational changes announced March 11, 1993. At that time, it was identified as the Office of Planetary Science and Astrophysics. The Office is headed by Dr. Wesley J. Huntress, Jr., the Associate Administrator for Space Science.

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NASA News

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For Release

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March 30, 1993

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RELEASE: 93-55

NASA AND CALIFORNIA WINE GROWERS JOINTLY BATTLE PEST DAMAGE

NASA's Ames Research Center, Mountain View, Calif., and California wine growers will use aerial and satellite images to battle a serious insect problem facing California's $10 billion-a-year wine industry.

Sensitive electronic scanners on aircraft and satellites will help a team from government, industry and several universities map and analyze root louse damage in northern California's premier wine growing region this summer.

"Scanners can detect plant stress before it is visible to the naked eye," said Joan Salute, AMES Project Manager for the Grapevine Remote sensing Analysis of Phylloxera Early Stress (GRAPES) project.

"This will help vineyard managers develop replanting plans. Replanting with resistant roots is the only way to rid the vineyards of the pest," she said.

About 65 percent of Napa and Sonoma counties' vineyards are planted with a grape rootstock vulnerable to a new strain of phylloxera. Phylloxera is an aphid-like insect that kills grapevines by sucking juice from the plants' roots. The bug nearly destroyed the vineyards of France and California more than a century ago, causing severe economic hardship.

The team includes Ames Research Center; Robert Mondavi Winery, Napa Valley; University of California Cooperative Extension, Napa; University of California, Davis; and California State University, Chico.

- more -

Robert Mondavi, which plans continued use of the technology, will make the results from the jointly financed $350,000-a-year, 3-year study available to other wine growers.

Field work using ground-based scanners to make initial measurements of leaves will begin in mid-April as the leaves develop. Images from infested and non-infested grapevines will be analyzed to determine the earliest detectable spectral differences.

The first remote sensing flights will be scheduled in mid-summer as the grapevine foliage increases.

"The spatial analysis offered by remote sensing and the potential for early damage detection are valuable tools for wine growers," Salute said.

"Satellite and aircraft scanners can map very large areas. When combined with a computerized geographic data base, they will provide crucial overviews of phylloxera spread patterns.

"Differences in soil and surrounding land use that may affect the spread patterns can then be assessed. We hope to learn enough about how, why and where phylloxera spreads to be able to develop relative risk maps for future infestations," she said.

"Understanding the spread of new infestation sites is critical," said Phil Freese, Robert Mondavi's Vice President of wine growing.

"Replanting is costly -- about $20,000 an acre. If we can determine the risk and pace of vine decline, we can better manage the financial investment of replanting. Developing methods for predicting phylloxera spread also will help us manage less catastrophic pests in the future," he said.

"Phylloxera damage is not usually visible until 2 or 3 years after the insect has been feeding on the plant," Salute said. "At that point, the plant declines rapidly and cannot mature the fruit for harvesting.

"Our multi-sensor, multi-scale approach will allow us to measure several early indicators of plant health. Scanners that record the visible and near-infrared light from grapevine leaves will detect nutrient deficiencies that eventually turn the leaves yellow."

Temperature is also an indicator of plant health. Stressed plants are warmer because they cannot efficiently pass water through their membranes. "Thermal scanners also will record subtle differences in grapevine temperatures," she said.

The GRAPES project is staffed by the Earth System Science Division at Ames. Funding is provided by the Office of Advanced Concepts and Technology (OACT), NASA Headquarters, Washington, D.C.

Tom Hatala, Program Manager of OACT's Commercial Remote Sensing Program, said GRAPES is a demonstration project designed to mature the technology associated with remote sensing applications and stimulate the remote sensing applications industry.

Hatala added that this partnership between government and industry should result in a new or improved commercial project or service, helping this applications area to expand.

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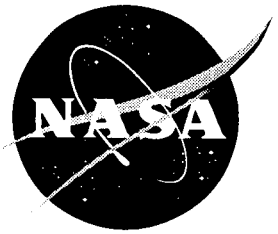

For Release

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March 30, 1993

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RELEASE: 93-56

NASA AWARDS CONTRACT FOR EOSDIS CORE SYSTEM

NASA has awarded a contract to Hughes Applied Information Systems, Inc., Seabrook, Md., to design, develop, integrate, maintain and operate the NASA Earth Observing System Data and Information System (EOSDIS) Core System.

The EOSDIS Core System (ECS) is a primary component of EOSDIS, which will be a geographically distributed system supporting operations and management of EOS in-orbit payloads. It will support the acquisition, processing, archiving and distribution of data from EOS and other U.S. Earth-observing spacecraft.

EOS is the centerpiece of NASA's Mission to Planet Earth, a comprehensive research program to study the Earth as a global environmental system. Mission to Planet Earth is NASA's contribution to the U.S. Global Change Research Program.

This will be the first project reviewed by NASA's newly established Program Management Council. The council currently is being established as a major element in a broad initiative of reform to improve program and project management.

The negotiated value of this cost-plus-award-fee contract is $766 million. Of this amount, approximately 7 percent will be subcontracted to small and disadvantaged businesses. Contract performance will begin immediately and extend through Oct. 31, 2002.

Hughes team members include Applied Research Corp., Landover, Md.; Center for Space and Advanced Technology, Fairfax, Va.; Electronic Data Systems, Herndon, Va.; Hughes Technical Services Co., Manhattan Beach, Calif.; Loral Aerosys, Seabrook, Md.; and NYMA, Inc., Greenbelt, Md.

- more -

Work will be performed at the Hughes facility in Landover, Md., and at the EOSDIS Distributed Active Archive Centers including those located at NASA's Goddard Space Flight Center (GSFC), Greenbelt, Md.; NASA's Marshall Space Flight Center, Huntsville, Ala.; NASA's Langley Research Center, Hampton, Va.; NASA's Jet Propulsion Laboratory, Pasadena, Calif.; the University of Alaska, Fairbanks; the University of Colorado, Boulder; and the Earth Resources Observations System Data Center, Sioux Falls, S.D.

EOS and EOSDIS are managed by GSFC for the Office of Mission To Planet Earth, Headquarters, Washington, D.C.

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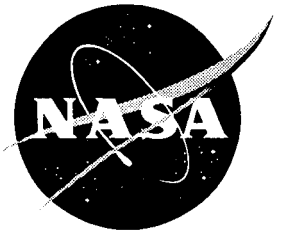

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March 30, 1993

RELEASE: 93-057

NEW TECHNOLOGY REINVESTMENT PROJECT SEMINAR SET FOR APRIL 1

NASA officials and officials from other federal agencies, participating in the Technology Reinvestment Project, will present a seminar on the project beginning at 9 a.m. EST April 1, in the NASA Headquarters Auditorium, 300 E. Street, S.W., Washington, D.C.

The goal of the Technology Reinvestment Project is to use nearly $500 million of appropriated Department of Defense funds to create new products and process technologies in nearly a dozen specific technological areas. The project also aims to promote and foster the transfer of existing federally-produced technology or processes into the commercial sector from existing defense industry areas.

NASA and the Advanced Research Projects Agency (ARPA) officials will provide an overview and explanation of the various components of the project during the 4-hour seminar.

The seminar is intended primarily for NASA employees and members of NASA's extended technology transfer community, including officials of the Centers for the Commercial Development of Space, the Regional Technology Transfer Centers and the National Technology Transfer Center. However, members of the public may attend if seating is available.

The following presentations and the presenters are scheduled:

- o Summary and overview by Lee Buchanan, ARPA Director of the Technology Reinvestment Program;
- o Concepts of the program common to the various agencies by Rick Dunn, ARPA General Counsel;
- o Technology development element of the program by Michael Long, Dept. of Energy;
- o Technology deployment aspects of the program by Phil Nanzetta, National Institutes of Standards and Technology;

- more -

o Manufacturing Education and other university curricula elements of the program by a National Science Foundation representative; and

o Proposal mechanisms which can be used with this program by John Jennings, NASA.

- end -

NOTE TO EDITORS: The seminar will be carried live on NASA Select television, Satcom F2R, transponder 13, 72 degrees west longitude. The seminar will be rebroadcast on NASA Select at 2 p.m. EST to accommodate those organizations in the western time zones. Media may attend the briefing. However, no questions will be taken during the seminar. Interviews can be set up with project officials following the presentations.

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N93-13: NOTE TO EDITORS

FIRST WOMAN OF HISPANIC HERITAGE TO FLY IN SPACE

Next month NASA plans to launch a Space Shuttle mission which will have special meaning for the nation's Hispanic community. The crew of STS-56 will include the first woman of Hispanic heritage to fly in space, Dr. Ellen Ochoa. The current launch target date is April 6, but is subject to change.

Dr. Ochoa was born in Los Angeles but considers La Mesa, CA, where she grew up and went to high school, her home. She has degrees in physics and electrical engineering, is an authority in optical recognition systems for space automation and is an accomplished concert flutist.

We have attached Dr. Ochoa's biography and a list of her assignments on the flight. Also attached is a description of the goals of the STS-56 mission, which is expected to make a major contribution to our understanding of the influence of the sun on Earth's atmosphere, especially the ozone level.

We thought you also might be interested in the growing relationship between NASA and a variety of Hispanic organizations.

(Publications that wish to have a glossy print of Ms. Ochoa's photograph should call the NASA Headquarters Broadcast and Imaging Branch, 202-358-1900.)

- end -